The economics of new educational media

Vol. 2: Cost and effectiveness

Educational methods and techniques 1

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The economics of new educational media

Vol. 2. *Cost and effectiveness*

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Preface

This volume is the second to be devoted to the problems of economic analysis of the new educational media. It reviews the work done between 1976 and 1978 under the medium-term programme approved by the General Conference of Unesco at its nineteenth session (Nairobi), which provides for assistance to Member States in determining the part played by new educational technologies in formal and non-formal education and measuring their cost effectiveness.

During the first stage of this programme, methods of analysing the costs of media with a view to international comparability were promoted by the Secretariat in close co-operation with the International Council for Educational Media (ICEM) and with assistance from the Institut de Recherche sur l'Économie de l'Éducation (IREDU), Dijon, France. Two meetings of experts were held in Paris in 1975 to try to develop a method of cost analysis and propose comparable units of measurement. The results of these meetings led to an initial publication, *The Economics of New Educational Media*, Vol. 1: *Present Status of Research and Trends* (Unesco, 1977). They were also examined at a conference of research workers specializing in economic analysis applied to the media which was held in Washington, D.C., in 1977. This conference was organized jointly by ICEM and the firm, EDUTEL Communication and Development, with the help of Unesco and the United States Agency for International Development (USAID). The years 1976, 1977 and 1978 constituted a test period during which a number of case-studies were carried out jointly by Unesco and the International Bank for Reconstruction and Development (IBRD). These studies, together with the methodological considerations to which they gave rise, were examined in June 1978 at a

conference organized in Dijon by the French National Commission for Unesco and the University of Dijon, with the help of Unesco, IBRD, ICEM and USAID. The theme of this conference was 'Economic analysis, a decisive factor in educational technology'.

The main papers submitted and discussed at these last two conferences are given in this volume, which consists of six parts.

The first part, in which results and problems are reviewed, opens with a comprehensive survey by Professor Jean-Claude Eicher summing up the studies undertaken since 1975 in regard to the analysis of costs and effectiveness; the second part comprises the case-studies made under the aegis of Unesco, USAID, IBRD and ICEM; the third contains abstracts of certain very recent studies which will be published separately; the fourth consists of the reports of the Washington, D.C., and Dijon conferences; the fifth an updated version of the world directory of specialized institutions and experts published in the preceding volume, and a supplement to the international list of studies on the economics of the new educational media; and the last part includes a bibliography which supplements the list of studies included in the preceding volume.

The designations employed and the presentation of material throughout the publication do not imply the expression of any opinion whatsoever on the part of Unesco concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. In addition, the authors are responsible for the choice and the presentation of the facts contained in this publication and for the opinions expressed therein, which are not necessarily those of Unesco and do not commit the Organization.

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Results and problems

Some thoughts on the economic analysis of new educational media

Jean-Claude Eicher

'Official' teaching has traditionally taken the form of direct contact between the teacher and a certain number of students. Nevertheless, there have been other forms of learning which, in some cases, have lasted a long time. After printing was discovered, and especially after the price of printing paper dropped in the nineteenth century, some people were able to teach themselves; but few possessed the degree of intelligence and tenacity required for this solitary effort. More recently, the development of the means of communication has given birth to teaching by correspondence and radio. However, these educational techniques have remained marginal.

The enormous growth in the demand for education over the past thirty years has forced us to take a fresh look at this problem. In fact, in most countries, governments, as well as those responsible for educational systems, first tried to satisfy this need by increasing the availability of traditional education. For this reason, between 1960 and 1965, the elasticity of public expenditure on education throughout the world went up to 2 and the percentage of the gross national product (GNP) spent on education increased from 3.78 to 4.90.

Most countries, however, began to lag behind in this endeavour, so that today we find two disturbing phenomena.

In developed countries, the elasticity of public expenditure on education in relation to the GNP has fallen back to 1 since the beginning of the 1970s and, in many countries, the education budget is hardly increasing at all in real terms. Education has thus ceased to be recognized as a priority item by national authorities. However, the demand by young people is, in general, continuing to increase and adults are more and more interested in further education.

In developing countries, the tremendous effort which has been made has not, in most cases, succeeded in eradicating illiteracy. In 1974, the gross enrolment at primary level was still below 60 per cent in thirty-two countries and in nine of them it was less than 25 per cent; and this takes no account of adults. There are also clear signs of a growing incapacity to bear the financial burden and of growing dissatisfaction with the outcome. The elasticity of public expenditure on education in relation to the GNP, while remaining clearly higher than 1, has declined considerably in comparison with the preceding decade; doubts about the effectiveness of this effort are growing with the rise in unemployment among graduates.

It is, therefore, only natural that the possibility of satisfying these immense needs by solutions other than 'traditional' schooling should be examined. The fact that technical progress has increased the capacity for transmission of all kinds of information over a distance has naturally directed research towards those systems which make use of the various media.

Examination by economists of the comparative cost structure has strengthened this trend, since it has led to a belief that educational methods using modern technological materials must normally have fixed costs proportionally higher than those of traditional education and consequently that they could lead to much bigger economies of scale.

It has, thus, very quickly become apparent that economic analysis could and should help throw light on the problems that educational planning faces today, by systematically comparing the cost and the effectiveness of the various solutions.

Such economic studies were at first dispersed and too specific to allow useful comparisons, but their number has now sufficiently increased and they have been standardized enough to supply us with instruments of use in decision-making.

But there has been such a variety of experience with the use of advanced technology in education, and the objectives pursued have been so complex and so different, that even those conclusions that most experts seem to regard as firm need to be looked at closely.

The aim of the present study is, therefore, to show what is accepted, to locate where differences of opinion exist and to point to the sometimes basic questions brought up by the methods used.

For purely didactic reasons, we will successively examine costs and benefits and then compare the two.

Observation and measurement of costs

Since educational systems using modern technological media are in general quite complicated to organize, it is essential first to reach agreement on what is to be measured and thus the different types of costs to be ascertained.

In so far as studies which are comparable from this point of view exist, we can try to draw conclusions from the results.

Definitions and methods of measuring costs

There has been considerable progress in this field. First, following the meeting of a group of experts in Paris in 1976 and another group of experts in Washington, D.C., in 1977, agreement seems to have been reached on the following points:

Studies must endeavour to start with a technical classification of costs in four categories: general administration, production, diffusion and use.

In each of these categories, it is essential, from an economic point of view, to distinguish between fixed and variable costs.

In general, besides the total cost, it is important to calculate an average cost (based on an appropriate criterion) and a marginal cost.

Costs by each category of operation must also be subdivided according to the source of the financing.

TABLE 1. Classification of costs

Technical costs	Economic costs according to the size of operation		Financial costs (by contributor)
General administration	Fixed	Investment	Educational authority
		Recurrent	Community
	Variable	Investment	Users
		Recurrent	Others
Production	Fixed	Investment	Educational authority
		Recurrent	Community
	Variable	Investment	Users
		Recurrent	Others
Diffusion[1]	Fixed	Investment	Educational authority
		Recurrent	Community
	Variable	Investment	Users
		Recurrent	Others
Use	Fixed	Investment	Educational authority
		Recurrent	Community
	Variable	Investment	Users
		Recurrent	Others

1. According to situation: transmission if radio; reproduction and distribution if it concerns printed documents; duplication and circulation if it concerns films, tapes, etc.

The majority of studies conducted over the past two years have in fact followed these rules when possible, thus making their interpretation and comparison much easier and more fruitful.

Serious problems none the less remain.

Some are due to the nature of the subject under study. In essence, the problems relate to measurement of the cost of using existing facilities and to the choice of a reference unit for the computation of average cost.

In the first case, the problem is of a practical nature because, in theory, everybody seems to agree on the necessity of measuring this cost like all the others.

In the second, there is a problem in so far as most of the costs vary according to the number of users and the length of use of the media but are not subject to the same rules, so that the cost is sometimes calculated per student and sometimes per hour. The solution that is being increasingly adopted is to calculate cost per student-hour.

Other problems are more closely linked to economic analysis in general.

We will single out the two which seem the most serious, the first being that of opportunity cost. The theoretical problem is well known. When a given economic activity requires not only the use of scarce resources, which means an expenditure for the person who undertakes it, but also the rejection of another activity that could have created goods and brought in an income, the value created by the rejected activity must be added to the expenditure incurred in order to obtain the total cost of the operation.

But this still leaves a difference in nature between the two cost categories—direct cost on the one hand and opportunity costs or potential income loss on the other—because, in one case, existing resources are mobilized and, in the other, the opportunity to create new assets is forgone.

For the opportunity cost to be a true cost, something must be rejected, that is, a possible choice must exist. Two problems must therefore be solved in order to measure it accurately: the existence of a choice and the value of the alternative solution that has been rejected.

There is a risk that these problems might introduce a certain ambiguity into the comparison of the costs of two educational systems. This is particularly true when distance learning systems are compared with traditional schools. The former are often considered more advantageous, partly because they enable professional activity to be reconciled with training. But in order to measure this advantage one must know exactly what the students would earn if they did not study, which is not always easy; an inaccurate calculation could falsify the comparison.

Finally, and perhaps even more serious, this argument raises the question of the optimal organization of an educational system. If distance education costs less than traditional schooling, why not have it generally adopted if it is as 'efficient' as traditional schooling? This touches the

heart of the problem of the comparability of the observed groups, to which we will revert in greater detail later on.

The second problem is that of the interest rate.

Again, in principle, the theory seems clear and accepted by all specialists. Investment creates capital which normally remains productive over a period of years, thereby freezing assets that might have been used to produce something else. It is necessary, therefore, to take capital productivity into account by adding to the annual amortization a sum corresponding to the rate of profit which has been renounced. In fact, this procedure is neither so easy to apply nor as clear-cut as it may seem.

First, it is important to distinguish between the annualization process, which consists in distributing the value of the investment over the presumed number of years of usage, and the use of an interest rate. The first procedure has only a practical goal, at least in theory—that of making the costs for one period correspond with the services rendered by the capital for that same period. For example, it would be absurd to apply the total cost of a building to the year of its construction.

Conversely, the use of an interest rate rests on an hypothesis that is neither clear nor indisputable. The reason often given is that interest might have been obtained by lending the funds instead of using them for the purchase of a building or equipment. However, this argument is not an explanation and its validity can easily be challenged in so far as it is not based on an economic theory. By itself, it consists of equating to a loss to the community or at least to the person acting in its name what the cost of rejection represents for one individual. As it is difficult to imagine a minister of education having a choice between spending his construction budget and lending it to a bank, it has to be assumed that the opportunity cost is zero.

If we go further and refer to the theories of interest, we find that, roughly speaking, they are of two types: those that put the emphasis on the supply side, the so-called 'loanable' funds theories which are based on the notion of preference for the present; and those that stem from demand and are based on the hypothesis of capital productivity. Only in capitalist economies where perfect competition existed would the confrontation of supply and demand give rise to a price of capital that would be 'the' interest rate.

However, capital markets are at best very imperfect and the concept of a social discount rate that could be derived from time preference on the part of the community is very vague.

This being so, it could seem that the conclusions to be found in many documents to the effect that (a) a positive rate of interest must be used; (b) 7·5 per cent appears to be a reasonable rate, do not rest on sound theoretical bases. On the one hand, nobody knows the actual time preference rate of the community and, on the other, one is not entitled to use for other various situations and types of communities a procedure that is fully justified only in a competitive capitalist economy.

Results of evaluations

As the number of studies using a comparable methodology increases, the majority of experts have reached agreement on the following conclusions:

The cost structure of distance education systems differs considerably from that of traditional systems; investment and fixed costs are higher and operating costs are generally lower.

The production costs of audio-visual educational programmes are, in general, much higher than the transmission and utilization costs, especially when it is possible to use an existing broadcasting network.

The economies of scale are very high in systems using mainly radio, television or computers; the marginal costs are thus very low even when there are a large number of students.

For all sizes of operation, the costs for systems using television are from three to ten times higher than for systems using radio, and the costs of computer-assisted learning systems are from ten to fifty times higher than those of systems using television.

Two other provisional conclusions may also be encountered, although expressed in much more cautious terms:

The cost per student and per year is generally lower in distance education systems using radio than in traditional systems.

This cost may even sometimes be lower in a multi-media system than in traditional systems.

These conclusions are much less dogmatic than those often found in previous studies. Despite the reserves expressed in them, they are none the less dangerous if the conditions required to ensure their validity are not stated as well. Furthermore, all studies on the cost of educational technology are subject to a degree of bias that must be measured and corrected.

Two essential conditions must exist if radio education is to be less expensive than traditional education.

Staff costs must clearly be lower than those in traditional educational systems. This implies at least that the number of hours spent by students and teachers together should be greatly reduced, i.e. that radio should not be simply an addition to regular teaching. It can also mean the use of less qualified teachers, but this solution is difficult to implement in public education due to the opposition of the teachers' unions.

A sufficient number of students must be reached to benefit fully from the economies of scale resulting from the use of modern technology. This condition is even more important for multi-media systems where fixed costs are higher. In addition, it should be noted that the only clear example of a multi-media system whose cost is significantly less than that of a traditional system and which addresses itself to a large public is the Open University where the principal technique of delivering the 'educational message' is print and not modern technology.

A word must nevertheless be said about the shortcomings which studies on the cost of educational technologies frequently suffer from and which are liable to bias comparisons in favour of such technologies.[1]

These shortcomings are as follows:

Because these experiences are fairly new, cost studies are often based on evaluations made before the project has actually been implemented, although it is a well-known fact that these costs are always underestimated, sometimes to a considerable degree. The latest example of this type of error is the Plato IV computerized educational system of the University of Illinois in the United States estimated first at \$1 per student-hour and today at \$5.

Studies often tend to omit the cost of the use of existing infrastructure, like State radio and television, since no expenditure is charged to the project.

Studies tend to overlook or underestimate the costs which correspond to new activities and which are, therefore, less easy to determine.

Since, by definition, traditional systems have been in operation for a long time and the different elements of their cost are well known, any comparison tends to favour artificially the systems using media and it is important to be very careful in evaluating them.

Finally, it must be noted that the results of cost studies conducted so far reveal considerable differences between one experiment and another. Thus, in the four educational television experiments mentioned by Jamison and McAnany,[2] the student-hour cost varies from \$0.575 to \$0.084, i.e. from one to seven, and in the four radio educational experiments from \$0.018 to \$0.331, i.e. from one to eighteen. It can therefore be seen that each experiment has its unique characteristics and it is dangerous to come up with an average and to draw specific conclusions from it.

To conclude this review of established facts and problems, it is fair to say that cost studies have progressed both in number and in quality and that the lessons which can be learned from them are interesting. However, we are far from having amassed complete and appropriate information and we must not only continue to measure costs, but also, as Leslie Wagner strongly suggests, pass on from estimating to analysing cost functions which is the only procedure that can help in coming to a decision.

1. We here take up some arguments developed by Martin Carnoy and Henry Levin, 'Evaluation of Educational Media: Some Issues', *Instructional Science*, No. 4, 1975, p. 385–406.
2. D. T. Jamison and E. G. McAnany, *Radio for Education and Development*, Beverly Hills/London, Sage Publications, 1978.

Definition and measurement of benefits

The situation is less satisfactory with regard to the study of benefits. The cost comparison of two alternative solutions to the same problem is obviously insufficient by itself to determine which one to choose, unless we are assured that their results are identical. In all other cases, it is the net summary of the costs and benefits that should influence the decision.

An analysis of benefits is therefore indispensable in most cases. When one studies economic activities on the market, one is interested in the benefits measured by the market, i.e. the profits. In the case of educational systems, on the contrary, a broader definition of benefits—and not only monetary ones—is chosen and one usually speaks in terms of effectiveness.

Nevertheless, cost-benefit analysis has been used by educational economists. The theory of human capital, based on the hypothesis that education increases productivity, and consequently individual profit, has led to an evaluation of the increased earnings resulting from education and thence, through a comparison with the cost, to a calculation of the rates of return on 'educational investment'.

To the best of our knowledge, no analysis of this type has so far been conducted to evaluate a cost-benefit summary of an educational experiment using modern technological media. Apparently there are two reasons for this. On the one hand, these experiments are mostly recent, and there are no data on the earnings of individuals taught under them. On the other, the objectives of these experiments are often multiple and not limited to the possible improvement of productivity.

But the notion of effectiveness has many facets and needs to be defined. Broadly, we could make the assumption that a system of distance education is more effective than a traditional system if it makes its users happier. The measuring of happiness, however, presents problems that the economist hesitates to approach. This is probably one of the reasons that one often finds measurements based on instructional effectiveness measured in its strictest sense, that is to say, by results of achievement tests. Data of this type are now plentiful enough to draw temporary conclusions; but it is important to give some thought to the value and the interest of such measurements.

Results of instructional effectiveness measurements

A look at these results and at what specialists say about them shows that agreement has been reached on one conclusion, while there is still doubt about a second question and disagreement on a third.

The conclusion which seems to be certain concerns the results of achievement tests. Almost all comparative studies show that students

having studied through distance education succeed just as well or better than those having completed the same programme in a traditional school.

There is doubt about the rate of drop-outs and repeaters. We do not have enough data on this problem to draw conclusions. It would therefore be very useful if, as of now, effectiveness studies attempted to gather this information.

The controversy concerns the effectiveness of multi-media systems as compared with single-medium systems.

Some authors feel that the use of a combination of media in a system always brings results superior to those reached by single-medium systems. In particular, such is the conclusion reached by Tony Bates.[1]

Others, however, such as Jamison and McAnany,[2] conclude that an analysis of results shows that students learn effectively through any medium properly used.

These results, though still incomplete and uncertain are, at first glance, encouraging; but careful examination of their meaning shows that they must be used with great caution.

Ambiguity and shortcomings of effectiveness indices

Three levels must be considered. The first and most obvious is the technical level: the indices used are imperfect. The second is that of the comparability of situations that must be assumed in order to interpret the measurement. The third concerns the objectives of the educational systems and leads to a discussion of the relevance of a measurement of instructional effectiveness.

Technical shortcomings

Even if one admits that a measurement of instructional effectiveness is useful to the planner, it has to be acknowledged that the measurements made so far are inadequate.

When studying primary and secondary education, it is necessary to observe simultaneously the level of knowledge acquired at the end of a cycle and the percentage of students who reach this level in 'normal time'. As we have already seen, however, this second condition is not always observed in the studies available.

In post-secondary education, the general analytical and synthesizing skills acquired are more difficult to measure. Evaluation in the conventional system is traditionally of a subjective nature with the scope of standardized tests useful for comparative purposes being very limited.[3]

1. Tony Bates, 'Options for Delivery Media', in H. Perraton (ed.), *Distance Teaching for Formal Education*, prepared by the International Extension College for the World Bank.
2. Jamison and McAnany, op. cit.
3. Leslie Wagner, study published in this volume, page 225.

Problem of comparability

In order to interpret test results directly, we must assume that 'all other things are equal'. Ideally, we would be concerned with the same population, some of whom would have followed traditional education and others distance education.

This situation is, in fact, rare. In almost all cases, a distance education system has been established precisely because there was a group that could not be reached by traditional teaching, whether for reasons of distance (scattered populations in out-of-the-way areas, for example) or because the students could not spend a full day in school (young adults already engaged in active life and not having been able to attend school at the normal age, for example).

Consequently, and even if one is satisfied with comparing traditional schooling with the use of media for immediately educational goals,[1] one cannot unambiguously conclude that the system giving the best test results is more effective, because we do not know how the population using the one system would have reacted in the other.

Let us take a concrete example to illustrate this: the study of a secondary-level educational system using correspondence and radio, established in the Republic of Korea in 1974. A detailed analysis of the effectiveness of this system has been conducted by the authors of this study. This shows that:

Internal efficiency, as measured by drop-out rates and rate of success in final exams, is higher than that of 'comparable' projects.

Instructional effectiveness, as measured by achievement tests for each subject, seems to be far superior to that of traditional schools, as the results were 42 per cent lower than those of other high school students at entrance and only 8 per cent lower after one year.

But we also learn from this study that the students differ considerably from average high-school students: (a) they are, on average, three to four years older; (b) 70 per cent of them have a job; (c) their social origins appear to be much more modest.

We also see that the conditions under which they study are quite different: (a) radio broadcasts last half an hour, cover two subjects during that time and are transmitted every morning between 5.30 and 6.00 and every evening between 10.00 and 0.30 depending on the stations; (c) contacts with teachers take place every other Sunday; (d) textbooks are more comprehensive than those used by 'ordinary' students.

It is therefore difficult to avoid the conclusion that students who enrol in distance education have different motivations from those of the

1. In this report, we say nothing at all about using the mass media for purposes which are broadly educational but cannot be considered as 'formal' teaching. We are nevertheless aware that these are very important fields that an economist must not overlook. For a sound examination of the various aspects of the problem, see Jamison and McAnany, op. cit.

average high-school student. Indeed, to be willing, although in employment, to listen to broadcast lessons so early in the morning and so late at night and to sacrifice one Sunday out of two to meet the teachers, a student must necessarily be more highly motivated than the average secondary school pupil.

Consequently, the main issue is the following: to what extent are those superior results due to the system and to what extent are they due to the student? In other words, what assurance have we that the students who persevere in a distance-education programme would not succeed even better—bearing in mind their strong motivation—in a traditional system if they were given financial support to attend classes?

We must thus be very careful not to confuse scholastic success with the effectiveness of the institution.

Instructional effectiveness and effects of education

Acquisition of knowledge is not the sole aim or the sole result of school attendance beyond the mandatory number of years and especially at the post-secondary level.

To mention only the main 'services', it is fair to say that the university offers the student:

The opportunity to associate with friends and professors, to get to know people who will help his career and perhaps even to see his life transformed by contacts with highly educated people.

The opportunity to obtain a degree which could in turn influence a prospective employer.

The opportunity to spend a few years more pleasantly than would perhaps have been possible if he had accepted a less qualified and relatively low-paid job, and this probably at a lower cost thanks to grants available for higher education.

The opportunity to acquire useful knowledge.

Evaluations of the effectiveness of educational systems, however, usually consider only the last of these points. This is especially disturbing when we remember that two conclusions are now generally accepted:

Groups who participate in distance-education programmes have as their first, and sometimes sole objective, the desire to acquire a means (generally a certificate) of improving their material and professional situations.

The correlation between level of education and level of earning which is almost universally observed seems only partially due to the acquisition of knowledge.

Inasmuch as the prestige aspect of a certificate predominates, it is essential to ensure that certificates issued by distance-teaching systems have, in the eyes of potential employers, as much value as the certificates issued by traditional institutions, particularly the more distinguished among them.

Finally, it is not necessary to emphasize how ridiculous an evaluation

of instructional effectiveness would be were the prevailing role of social and/or racial origin in professional success demonstrable.

The measurements of effectiveness currently used in the area of educational technology are, therefore, inadequate and must be improved. But the comparison of cost and effectiveness presents some other problems.

Problems of cost-effectiveness analysis

The principle of cost-effectiveness analysis is the same as that of cost-benefit analysis and is well known. The aim is to prepare an accurate statement of the sacrifices and the benefits involved in alternative decisions so as to permit the choice of the one offering the biggest net advantage.

The use of this technique, however, in the case which concerns us—the choice of an educational system—poses two types of problem. In view of their complexity, we will state them briefly here.

First, there is the problem of cost-effectiveness analysis as opposed to cost-benefit analysis. Second, there is the problem of using the results for educational planning.

Limits of cost-effectiveness analysis

Cost-benefit analysis should result in the establishment of a precise index. This can be done because such an analysis works with variables that can be measured by the same standard: money. Thus, by comparing costs and benefits in terms of money, a rate of return can be established.

This is not the case with cost-effectiveness analysis. The concept of effectiveness is broader than the concept of benefit or economic advantage because it has several dimensions. We could define the effectiveness of a process as its capacity to attain the goals determined by the system. In the case of an educational system, these objectives are both numerous and impossible to measure with the same yardstick. For instance, it is quite impossible to establish objective criteria enabling a decision to be made as to whether the acquisition of ten new 'bits of knowledge' by one half of the class and of two new 'bits of knowledge' by the other, less-gifted half equals the acquisition of six 'bits of knowledge' by the whole class; and it is still more difficult to compare progress in teaching and in research since these two objectives coexist in higher education, but are partially competitive.

But even if we reduce effectiveness to one of its dimensions, i.e. the instructional one, a comparison with cost is not possible because the unit of measure is not the same. Consequently, cost-effectiveness analysis allows only the separate comparison of each variable measured in two different situations. It can, at best tell us if the cost of system A is higher or lower than system B and the same for its effectiveness.

If the cost and effectiveness of A are both 10 per cent lower than B, however, it is wholly impossible to conclude that both solutions are absolutely equivalent.

Cost-effectiveness analysis therefore only provides information that must be evaluated by the decision-maker; it does not provide objective and definite criteria of choice.

Cost-effectiveness analysis and educational planning

Cost-effectiveness analysis is based on the observation of existing situations. Experiments in using the media for educational purposes present two characteristics which make the extrapolations necessary for decision-making dangerous.

These experiments are all different from each other. This is essentially due to the fact that the use of the media for education is too recent to be far removed from the trial-and-error stage.

It is impossible, therefore, to draw from the case-studies conclusions which are generally applicable.

The cost of technical facilities evolves very quickly and not always in a predictable way. Hence it is possible that even a close imitation of an existing system could imply a different cost.

The development of a new educational institution using modern technological media remains, and will remain, partly an 'act of faith' as has been said of the Open University.

Conclusion

In this survey, we have particularly emphasized the limitations, difficulties and dangers of analyses which are too directly derived from neo-classical economic analysis and which therefore share its technical limitations as well as its ideological presuppositions. None the less, these efforts have their use, particularly the study of cost functions which will enable decision-makers to determine the financial implications of alternative policies.

We must take heart from the tangible progress achieved over the past few years and continue to work towards elimination of technical inadequacies and limitation of the field of value judgements.

Cost analysis in educational technology:[1] practical problems

F. Orivel

The first conference on the methodology of cost studies was organized by Unesco in January 1975 in Paris. A summary report of the conference was presented by Jean-Claude Eicher (1975).[1]

A smaller panel of experts then met in June 1975 to try to resolve some of the points raised by the Eicher report. A report on this June meeting was made by the author (Orivel, 1975).[2]

While Unesco was working to achieve agreement on methodology within the international community, the United States Agency for International Development (USAID) commissioned from Jamison, Klees and Wells a manual, with supporting examples, on cost analysis in educational technology: *Cost Analysis for Educational Planning and Evaluation: Methodology and Application to Instructional Technology*, 1976.[3]

Since these papers were published, two case-studies largely based upon them have enabled us to make a first appraisal of these recommendations and, in particular, to raise some new questions to which this conference should attempt to find answers. The case-studies concern two experiments in school television, one in the Ivory Coast, studied by Eicher and Orivel for the Academy for Educational Development,[4] and one in the state of Maranhão, Brazil, which was examined for Unesco by Arena, Jamison, Oliveira and Orivel.[5]

The present working paper will recapitulate the main points of the three papers on methodology mentioned above, and will raise a number of questions of implementation arising from the case-studies.

1. Working paper presented at the Conference on the Economic Analysis of Educational Media, Washington, D.C., 2–4 March 1977.
2. Published in *The Economics of New Educational Media*, Vol. 1: *Present Status of Research and Trends*, Paris, Unesco, 1977 (Educational Methods and Techniques, 1).
3. Also published as *The Cost of Educational Media: Guidelines for Planning and Evaluation*, Beverly Hills, Calif., Sage Publications, 1978.
4. *Cost Analysis of Primary Education Through Television in the Ivory Coast*, Washington, D.C., Academy for Educational Development, February 1977, cf. case-study in this book, page 105.
5. *Economic Analysis of Educational Television in Maranhão, Brazil*, Paris, Unesco, February 1977, cf. new version in case-study below, page 187.

Categories of costs and their measurement

Classification of costs[1]

Four types of classification of a complementary nature seem necessary if we are to obtain a complete picture and if the categories are to be sufficiently detailed to allow comparisons:

First, a technical classification in which costs are categorized according to the various technical operations that have to be carried out for information (an educational 'message') to be received by the person or persons for whom it is intended.

This classification raises problems of nomenclature, since certain costs are difficult to classify in one of the four categories, namely formulation of the message, production, transmission or distribution and reception. For example, in which category should we place expenditure on the duplication of the recorded messages (films, tapes, etc.)? We could consider classifying them under production (for as many copies of the recorded message as will be required must be produced), under distribution or under reception. There is also the cost of rental or installation of cables for closed-circuit television, or the cost of maintaining liaison with the 'pupils'. But these are, we believe, more often than not questions of common sense: all that is required is for the person carrying out the study to define and justify his choice.

The relative cost of each stage in the process varies considerably according to the technical medium used. (Thus transmission costs are generally higher, in terms of production cost, for television than for radio.)

Second the economic classification distinguishes costs according to whether they are variable or invariable, having regard to the dimension of the operation.

It will be seen that certain invariable costs are fixed costs, i.e. they are incurred once and for all, or at least at considerable intervals (projection apparatus, for example), whereas others are recurring, i.e. they are repeated from period to period (maintenance staff salaries).

Certain authors include in their costs both the purchase price of equipment and an annual amortization in respect of such equipment. There is a danger here of including items twice, to the extent that the cost of repairs and maintenance, as well as the purchase of new equipment, are both reckoned.

Some authors add an interest charge to amortization. From the wider economic standpoint, this is correct, since we are dealing with scarce resources that would have brought in a return if loaned (or invested

1. cf. J. C. Eicher, 'Cost-effectiveness Studies Applied to the Use of New Educational Media. Methodological and Critical Introduction', *The Economics of New Educational Media*, Vol. 1, op. cit., p. 17 et seq.

elsewhere). But since all we are doing is to compare the relative cost and effectiveness of different educational methods this addition is not necessary, and its omission obviates the need to make a choice—always arbitrary—of interest rate.

The amortization calculation should be based, in theory, on the obsolescence and technical wear of equipment, but in practice it is sometimes better to opt for a 'financial' amortization which takes into account the evolution of sources of finance and of currency resources where certain equipment has to be purchased abroad.

Not only total costs, but also unit costs should be calculated. The two most useful categories of unit costs are cost per hour of contact and cost per student. They can be brought together to form a combined index: cost per student-hour.

Some of these unit costs may prove invariable, where the corresponding total cost varies in proportion to the reference variable (number of hours, number of students or number of student-hours).

Third, the accountancy or budgetary classification distinguishes between capital (investment) expenditure and operating expenditure.

This distinction can be useful, inasmuch as it allows comparison of the cost of the initiatory stage, and the current operational costs of an established system. The figures needed for this classification, moreover, are often those most easily available. However, it is neither essential nor wholly satisfactory, since: (a) it contributes nothing further than the economic classification, in so far as the latter can be obtained in its entirety; (b) it is useless once the initial investment has been made, as only operating expenditures are subsequently involved; (c) it is not normal budgetary practice, in the case of public funds, to include amortization charges in the operating expenditure budget.

Finally, the financial classification by contributor enables a distinction to be made between direct and indirect costs.

This classification distinguishes between costs which are to be met by the organization responsible for capital investment, cost to be met by users, and costs falling to the community.

The distinction can be particularly useful in instances where the proportion to be met by the two last payers is substantial. Its importance is heightened by the fact that the evaluations made in the studies reviewed often tend to underestimate or to overlook these catagories completely. Let us take the examples of a project involving the part-time use of an existing television channel. The direct cost of the operation—the only one generally reckoned—does not include use of this channel because it appears to be provided free of charge. Nevertheless, the costs of setting up transmitters and relay installations were incurred at the outset with a view to the full-time use of the channel; logic would then require that this investment should be charged to the educational system in proportion to the hours used. Failure to reckon this indirect cost is tantamount to self-delusion concerning the real cost of such an operation, since it amounts

to believing that there will always be ready-installed transmitters providing a channel with available hours that can be 'appropriated' free of expense.

Similarly, if part of the cost is met by the student (the purchase of a television receiver, for example, in the case of 'tele-education'), failure to include it amounts to shifting, in an insidious fashion, the burden of the educational system from the public authorities to the individual.

To sum up, the classification in Table 1 may be suggested as one which provides an exhaustive and 'realistic' picture of costs.

TABLE 1. Classification of costs

Technical costs	Economic costs	Financial cost (by contributor)
Conception	Fixed Invariable Variable	Educational authority Community Family Others
Production	Fixed Invariable Variable	Educational authority Community Family Others
Transmission and distribution	Fixed Invariable Variable	Educational authority Community Family Others
Reception	Fixed Invariable Variable	Educational authority Community Family Others
TOTAL	TOTAL	TOTAL

These costs can be calculated per student, per hour or per student-hour, according to need. Some of the spaces can obviously remain empty. We can now review what we already know concerning costs and their variations.

Problems of application

Several points seem to us to need reconsidering in this approach.

First, no distinction is made according to media. Such a distinction may be implied but we believe it is fundamental. Many studies ignore this aspect.

In the examples of the Ivory Coast and Maranhão, schools television broadcasts are accompanied by printed matter. It is possible to conceive of a television-based technology without written materials, or written materials without television. The costs of the two media must therefore be isolated from each other as far as possible.

Moreover, all the media utilized must be accounted for, including the teacher—often the most expensive medium.

Integrating the costs of teachers in this way can create problems. If we apply the concept of production to the case of the teacher, this means we shall have to include the cost of his or her training when costing the teacher as a medium. This is, in fact, what is done in the Ivory Coast, where the educational television budget includes the training costs of local teachers. The cost studies of this experiment include training costs (in general). But in other contexts, as in Maranhão, the problem is different in that there exists on the labour market a glut of qualified instructors. Educational television there is barely concerned at all with their training and it is impossible to include training costs in the global analysis of the experiment.

Second, the book raises the question of the inclusion of the costs of duplicating the recorded 'messages' (films, magnetic tapes, etc.). To these may be added printing costs.

Experience has shown that it is particularly useful, in this specific case, to be able to separate fixed costs from variable costs.

In other words, the heading 'production costs' should cover as far as possible all the fixed costs. In this connection we propose to abolish conception costs as a separate heading, as they are virtually impossible to calculate, and to include them under production costs. Duplication or copying costs can either be grouped under a separate heading of their own, or included under the second heading, distribution costs —which take different forms according to the medium under consideration: transmission in the case of broadcasting, printing and distribution in the case of printed matter, copying and distribution in the case of films or photographs.

Third, the economic classification of costs into fixed, constant and variable is perhaps unnecessarily complex.

We propose to call 'fixed' costs those which are independent of the number of students, and 'variable' costs those which do depend on the number of students. Within each type of cost there may be current or operating costs, repeated year after year, and capital costs which we have to translate into annual amortization charges according to the life expectancy of the equipment.

Fourth, Eicher believes that in general it is unnecessary, in comparing two technologies, to use a discount rate. We do not share this view, since it presupposes two conditions which in most cases are not fulfilled: (a) the ratio of capital to recurrent costs varies from one technology to another; (b) the working life of equipment varies between different technologies.

We propose therefore to calculate expenses on an annualized basis, using three discount rates: 0 per cent, 7.5 per cent and 15 per cent, as recommended by Jamison, Klees and Wells (1978).

Finally, financial classification according to contributor introduces the idea of direct and indirect costs. These in fact are the additional costs

of using existing structures, for instance when a commercial television studio is used to make schools television programmes. The direct costs here are the marginal costs incurred for educational use of the installation. The indirect costs are those which have to be added to the marginal costs in order to calculate average costs, i.e. an attribution in respect of fixed costs (amortization of equipment plus incompressible current costs).

Description of physical resources

Table of physical resources[1]

The proposed table (Table 2) should be drawn up for the four technical categories corresponding to the implementation of a system: (a) conception costs, (b) production costs, (c) distribution costs, and (d) utilization costs.

TABLE 2. Proposed standard for costs

Number of hours × number of students: . . . × . . .			
1. Buildings of general nature	Area (m^2)	Hours of use per annum	Life expectancy
2. Special buildings			
Studios	Area (m^2)	Hours of use per annum	Life expectancy (years)
Other	Area (m^2)	Hours of use per annum	Life expectancy (years)
3. Equipment and materials[1] per type	Quantity	Hours of use per annum	Life expectancy (years)
4. Consumable furniture and spare parts per type	Quantity		
5. Labour per qualifications[2]	In man-months per year		
6. Other resources			
Energy per type and mode of transmission		Quantity	
Other		Quantity	

1. Transport vehicles should be noted here.
2. Qualification should at least indicate the level of education received at four levels: without qualification, primary, secondary or higher education.

Application

In Volume 1 of *The Economics of New Educational Media*, we stress the need for a description of the physical resources used. Experience has shown

1. From: F. Orivel, 'Standard Tables for Cost Measurement', *The Economics of New Educational Media . . .*, Vol. 1, op. cit.

convincingly how useful this recommendation is. For example, the exorbitant cost of supplying electricity for television receivers in the Ivory Coast would be incomprehensible but for the knowledge that they use alkaline batteries. Sometimes it is appropriate to go further than the recommendation. For example, in the Ivory Coast again, foreign technicians, still present in some numbers, cost much more than their Ivory Coast counterparts, and it is important to point out the cause of this difference in cost.

However, in many cases, a precise description of physical resources would be unnecessarily long. In Maranhão, the equipment inventory covers several hundred pages. The dull, tedious nature of such a list will be immediately apparent.

Consequently, the important thing is to choose useful information, that which allows for a clear, overall impression of the system's basic characteristics and the kind of resources brought into play.

It has been suggested, moreover, that input in terms of human resources should be measured in full-time equivalents. This seems a wise idea but, here too, in practice it is somewhat more complex. Thus, in the state of Maranhão, in Brazil, the notion of full time is difficult to define. A teacher's normal working week consists of five times five hours, either in the morning or in the afternoon, or twenty-five hours in total. But he can take on a second 'week' of twenty-five hours during his free half days, or do a part-time administrative job. Which definition of full time are we to adopt?

Multiple inputs to the cost function

Cost functions

The extract which follows is taken from the work by Jamison *et al.*, 1976, referred to above.

We have assumed that the total cost of providing instructional radio or television depended on only a single variable, the number of students reached. This is a reasonable approach in circumstances where one can assume other potentially relevant variables to be fixed. Often, however, particularly in planning situations, it is important to consider explicitly the other variables. The input one wishes to cost is not just instructional television for N students. It is instead instructional television for h hours per year for N students spread over a geographical region of x square miles. More variables could be added.

While treatment of multiple inputs involves some additional complication, the basic concepts introduced so far change but little. Total cost is now a function of several variables; in our new example, $TC = TC(N, h, x)$, the marginal costs become the amount total cost changes for a unit change in each

of the determining variables: in this three-variable example, we have three marginal costs defined mathematically by partial derivatives as follows:[1]

Equation 1

$$MC_N = \frac{\alpha TC}{\alpha N}: MC_h = \frac{\alpha TC}{\alpha h}: \text{and } MC_x = \frac{\alpha TC}{\alpha x}$$

Each of these partial derivatives can be a function of N, h, and x. Likewise there is a number of average costs—the cost per student, TC/N, the cost per hour of presentation TC/h, etc. In addition, however, one may wish to consider composite averages: for example, the cost per student-hour. That cost would be TC/Nh.

Aside from potential practical complications, then there is small conceptual difficulty in going from consideration of a single determinant to multiple determinants of cost. In the analysis of the cost of ongoing projects, we will rely heavily on a cost function model that assumes total costs to be a linear function of the annual number of students in the system, N, and the annual number of programming hours, h, as follows:[2]

Equation 2

$$TC\,(N, h) = F + V_N N + V_h h,$$

where
F = the fixed costs of the system in the sense that they are independent of N and h;
V_N = the variable cost per student;
V_h = the variable cost per hour of programming broadcast.
In order to let the number of students and programming hours in the system to be the sole determining cost variables, as in equation 2, it is necessary to let the values of F, V_N and V_h depend on aspects of the system that are assumed to remain unchanged. F will depend, among other things, on the number of grade levels the students to be reached are in, as well as the geographical area over

1. Similar to the discussion for any given value of N, h, or x, the marginal cost with respect to N, h, or x, can also be represented by the increase in total cost caused by adding one student, one hour of programming, or one square mile of coverage, respectively. This formulation would yield an accurate estimation of marginal cost only for a specified level of N, h and x, from which we want to examine an incremental expansion of one of the variables, holding the other two constant. The derivative formulation again has the advantage that it yields a *functional* representation of the marginal cost with respect to N, h, or x that allows one to calculate the marginal costs of expansion of N, h or x, at any level of the three variables without having to calculate the total costs in each instance.
2. It should be noted that a more detailed formulation of the total cost function would have several different types of h variables: production costs depend most closely on the number of programming hours *produced* each year; transmission costs depend on the number of programming hours *broadcast* annually; and reception costs will vary somewhat (due to the costs of supplying power to the television or radio receivers) with the number of programming hours the average television or radio set *receives* annually.

which they are spread, V_h will depend on the quality of programming, while V_N will depend on class size. To the extent that the situation warrants assuming these other variables will change little the use of a simplified cost function such as that presented above in equation 2 is warranted . . .

. . . *Treatment of time: student utilization over time*

Our purpose is to develop a method for displaying the unit costs of an educational investment that takes explicit account of the time structure of utilization as well as costs and that allows examination of costs from a number of time perspectives. The question of time perspective is important. Before undertaking a project, a Minister of Education faces the substantial investment costs required to buy equipment, develop programmes, and start up the operations; three or four years later these costs will have been incurred to a substantial extent and the cost picture facing the Minister is very different indeed. His initial capital costs are sunk, and except for the potential (slight) resale value of his equipment, there is nothing to be recovered from abandoning the project.[1] What is desirable, then, is a method for displaying costs from the perspective of a decision-maker prior to commitment to a project, one year into the project, two years into the project, etc.

It is also desirable to consider various time horizons for the decision-maker. What will the average costs have been if the project is abandoned after three years? Allowed to run for 15 years? This suggests the value of looking at average costs (1) as seen from year i of the project with a horizon through year j. We will denote the 'average cost from i to j' by the symbol AC_{ij} and define it to mean total expenditures on the project (number of students), with both costs and usage discounted back to year i by the social rate of discount, r (2). Let C_i be equal to the total amount spent on the project in year i, including fixed and variable costs, and capital and recurrent costs. Let N_i be the total number of students served by the project in year i. Then AC_{ij} is given by (3).

(1) One could also look at total and marginal costs; in our treatment here we focus on average costs because we feel them to be useful in aiding the decision-maker's intuition, prior to project commitment. Expansion decisions should, of course, rely on marginal costs. The concept AC_{ij} being developed here is implicitly based on the concept of a vector valued total cost function, where the dependent variable is a vector giving total cost in each time period. The independent variables, too, become vectors potentially assuming different values at different times.

(2) It may aid in understanding equation 3 below to explain the concept of the present value of a cost. Assume that a cost of 4,000 dollars is to be incurred 8 years from now. The *present value* of that cost is the amount that would have to be put aside now, at interest, to be able to pay the 4,000 dollars in 8 years. If the interest rate is 6% and we put aside an amount z now, in 8 years we will have $z\,(1.06)^8 = 4{,}000$ dollars, or $z = \$4{,}000/1.06^8$. z is the present value of \$4,000 8 years from now when the interest rate is 6%; its numerical value is \$2,509.65. The numerator of equation 3 is the present value (viewed from the perspective of year i as the 'present') of all costs incurred between years i and j. The denominator is the present value of student utilization.

1. It may none the less be wise to abandon the project—if, to be specific, still to be incurred costs exceed the benefits of continuing.

(3) It should be noted that the potential for the use of the AC concept is much greater than would be indicated by the restricted definition given here, focusing on average cost per student. For example, for instructional technology project evaluation it may be as, or more, useful to think of utilization in student hour terms and the denominator could be redefined as such. More generally, the denominator could be defined in terms of any input or output of any production process, and need not only be applied to educational evaluation.

Equation 3

$$AC_{ij} = \frac{\sum_{k=i}^{j} C_k/(i+r)^{k-i}}{\sum_{k=i}^{j} N_k/(i+r)^{k-i}}$$

A decision-maker at the beginning of i can in no way influence expenditures of student usage before time i so that costs and benefits incurred up to that time are for his decision irrelevant and are not incorporated into AC_{ij}. What AC_{ij} tells him is the cost per student of continuing the project through year j; under the assumption that year j will be the final year of the project. By examining how AC_{ij} behaves as j varies the decision-maker can obtain a feel for how long the project must continue for unit costs to fall to the point of making the continuation worth while. When the decision-maker is considering whether the project should be undertaken at all, he should let $i = 1$; i.e. he should compute AC_{ij} for various values of j. In these considerations ideally the decision-maker should base decisions on the value of AC_{ij} calculated for the j corresponding to the end of the project, for his discounting of the future is already taken into account by equation 3. In the real world, however, there is a possibility that the project will be terminated prior to its planned end, and it is thus of value to the decision-maker to see how many years it takes AC_{ij} to drop to a reasonable value and how many years more before it stabilizes to an asymptotic level. Clearly projections such as these rest on *planned* costs and utilization rates.

At this point it may be of value to include a brief example to illustrate the concepts: in our example we assume a project life of 6 years. In year i a $1,000 investment is made and no students use the system. In years 2 through 6 costs of $250 per year are incurred and 50 students per year use the system. Table 1.4 shows C_i and N_i for each of the 6 years of the project, and Table 1.5 shows AC_{ij} under the assumption that the social rate of discount is 7.5%.

We should make a few comments about the values of AC_{ij} in Table 1.5.

TABLE 1.4. Example cost and student usage

Year i	C_i (in $)	N_i
1	1,000	0
2	250	50
3	250	50
4	250	50
5	250	50
6	250	50

TABLE 1.5. Example values of AC_{ij}

	Horizon year j					
Year i	1	2	3	4	5	6
1	–	26.46	16.14	12.69	10.97	9.95
2		5.00	5.00	5.00	5.00	5.00
3			5.00	5.00	5.00	5.00
4				5.00	5.00	5.00
5					5.00	5.00
6						5.00

First, there are no entries in the lower left; this is natural because the horizon j must be at least as far into the future as the time from which it is viewed (i). Second, for values of i greater than or equal to 2, AC_{ij} is uniformly \$5.00 (= \$250/50). This is because the only capital cost is incurred in period 1 and from period 2 on, future costs and utilization are discounted to the present in the same proportion. (It is natural, once the capital cost is incurred, that the decision-maker view the unit cost as \$5.00 from that time on). Third, AC_{ij} is infinite: because costs have been incurred and no students have used the system, the unit cost becomes indefinitely large. Fourth, in this example the interesting numbers occur in row 1. As the time recedes further into the future, the unit costs are spread over more students reducing AC_{ij}: if the project had a long enough life, AC_{ij} would become closer and closer to \$5.00 as j got larger. AC_{ij} shows how the average cost behaviour of the project looks prior to its initiation, and the value of AC_{ij} (for j near the project lifetime value) should be important in determining whether to proceed. The AC_{ij} estimate, like that of the average cost per student based on a annualized cost function, is also quite sensitive to the social rate of discount chosen. In fact, not taking account of social time preference (*h* that is, utilizing a zero discount rate) usually understates the AC_{ij} measure by an even greater amount than that indicated for the annualized specific year, average cost measure which we discussed.

It is the author's opinion that the AC_{ij} cost concept is a much more meaningful summary cost measure than that provided by calculating the average cost per student from an annualized cost function, based on student utilization in one particular year. The latter figure merely gives a snapshot picture of project efficiency (in a cost sense) at one point in time, while the AC_{ij} measure captures both the history and projected plans for the particular project under consideration. In effect an average cost per student figures is a very rough cost-effectiveness ratio that tells an analyst the resource costs of giving an individual a year's education (of given quality); it would seem to make good sense to evaluate this particular aspect of the cost-effectiveness of a project over the project life-time, and not for any particular year. Nevertheless, since most previous analyses uses an average cost figure based on an annualized cost function, we will also present such calculations for selected years for the case-studies; wherever sufficient cost data are available, we will also present estimates of the AC_{ij}'s.

It should be noted that in the absence of perfect markets there is no necessary reason to choose the same interest rate for discounting both costs and students, as was done in equation 3 above. It is entirely possible that the rate of time preference relating to students receiving an education and that associated with resource investments may be different, although in the absence of a

specific notion of what this discount rate difference may be, the same rate will be applied to both resources and students in the analysis of instruction of technology costs. It is interesting to observe that in an entirely separate effort, Levin[1] also suggests the use of a cost concept which takes into account system utilization over time, and which additionally would discount this utilization stream by an appropriate discount rate; in essence, his suggestion amounts to a general description of the type of AC_{ij} concept we have developed and presented above.

Application of cost functions

Cost-function estimates, based as they are on the distinction between fixed and variable costs, meet with three types of difficulty:

1. Those fixed costs which are normally considered (administration, production, transmission) are not strictly speaking fixed. If a project increases significantly in size, it would be a mistake to think that its administration costs will not rise also. But we have few means of determining in what proportion these costs will rise.
2. Certain fixed costs may increase sequentially, and each sequence can differ from the preceding one. This is the case, in particular, with a television system's network of transmitters. The first zone to be covered is generally the easiest, the one which reaches the largest number of students. The network is then extended in phases and each new zone will differ, both in terms of the cost of the extension and in terms of the number of potential students.
3. Finally, certain variable costs may show a non-linear variation, i.e. they may not be strictly proportional to the number of students. In particular: (a) base costs, i.e. teachers and classrooms, tend towards a slight increase in many cases, because of a fall in the average number of students per class or increases in salaries in real terms; (b) unit maintenance costs generally show a decline. Thus, in the Ivory Coast, extending the system has led to a more rational deployment of maintenance services, thereby reducing costs per class; (c) in the Ivory Coast again, the substitution of solar batteries for alkaline batteries will lead to progressive reductions in the cost of supplying electricity for television receivers.

In the examples of the Ivory Coast and Brazil, the absence of real variable costs made it impossible to calculate Jamison, Klees and Wells' cost function, with its third term designed to account for variable costs in the production of television programmes. Thus, in the Ivory Coast, the volume of television production could be increased considerably (and probably more than doubled) at virtually zero marginal cost. In Maranhão, where there is far less production capacity (two studios instead of five), up to 700 programme hours per year were being produced at a time when video-tape

1. H. M. Levin, 'Cost Effectiveness Analysis in Evaluation Research', in: M. Guttenberg (ed.), *Handbook of Evaluation Research*, Sage Publications, 1974.

stocks were insufficient. At present, the figure is about one quarter of that, around 175 hours per year, which gives an idea of the great elasticity of their production.

The problem of output standardization

With 700 programme hours per year from two studios in Maranhão, and on average about 100 hours per year from five studios in the Ivory Coast, the question arises of the level of programme quality. In Maranhão, about two-thirds of the television programmes consist of a recording of an instructor in medium close shot, delivering his lecture, which is sometimes illustrated by photographs or hand-drawn or printed pictures. On the other hand, the Ivory Coast's programmes tend more to resemble the 'dramas' of commercial television, which clearly cost much more. In other cases, for example, in the United States, the recorded programme consists solely of the instructor's 'talking head', thus reducing costs to a very low level. At the other extreme, for example, the Open University in the United Kingdom, programme production comes very close to the standards of film production for the cinema. This considerable diversity of types of output gives rise to a very wide divergence in cost per hour, as follows: $100 for the instructor's 'talking head'; $500–$2,000 in Maranhão; $5,000 in the Ivory Coast; $20,000 at the Open University.

How can these four products be compared? Are they homogeneous, or are we to consider them as four different products?

Finally, we would stress that there is practically no information available to indicate the comparative degrees of instructional efficiency of these four products.

Problems of marginal costs

Here we consider the case where one of the input resources is common to several utilizations. A typical case is that of a broadcasting network, used both for educational purposes and for the general public. There are three kinds of situation:

Case 1: School television finds an existing network which is under-utilized and which, in particular, is free during school hours. Logically, school television carries the marginal utilization costs of this, including both the cost of additional electricity and low charges for extra maintenance and supervision. This is the case, for example, in the Ivory Coast.

Case 2: At the other end of the scale, school television is set up within the area of coverage of the existing network, or even in a zone where the

network has insufficient transmission time available during school hours. If, as is the case in Maranhão, the school television system has to take upon itself the establishment and all the operating costs of the transmission network, these costs are no longer marginal.

Case 3: Finally, between these two situations, schemes for joint use of networks involve calculation of the average cost per hour which is then charged to the users according to the number of hours of use.

This type of charging problem occurs not only in connection with the transmission network but also for many other elements such as: (a) use of television production facilities for extracurricular purposes; (b) use of television receivers in schools for other purposes—thus, in the Ivory Coast, we allocated to non-educational purposes 20 per cent of the (very high) cost of supplying electricity to television receivers in schools (should we have proceeded in the same way with the purchase costs of receivers, aerials and masts, and their maintenance?); (c) use of duplication equipment for non-educational printed matter.

Economic analysis and education: critical issues in application to instructional technology evaluation[1]

Steven J. Klees and Stuart J. Wells

Outcome measures

Much attention has been centred upon cognitive achievement, as measured on standardized tests, as the sole criterion of educational effectiveness. While this is an important process outcome, it is by no means the only one of interest. Other effectiveness measures considered important include changes in: the distribution of test scores to determine potential reductions in educational outcome inequality; drop-out rates; repetition rates; analytic capabilities; creativity; inquisitiveness; and a wide range of social and economic behaviour. To a developing country expanding its educational system, differences among systems in terms of the rapidity with which the school population can be reached are also of importance.

1. Working paper presented to the Conference on Economic Analysis of Educational Media, Washington, D.C., 3–4 March 1977.

For non-formal education programmes such as those in community development or agriculture, imparting knowledge is of obvious importance. However, there should be an even greater interest in fostering an ability to convert knowledge gained into action. The changes in agricultural production derived from the action would be considered a benefit. Interest might also be displayed in creating a self-help or innovative capacity within certain population groups. A more direct, yet less satisfactory, effectiveness measure for non-formal education may be the size of the audience attracted to the programmes.

To make decisions about educational alternatives, it is essential to evaluate educational outcomes such as those above. Economic analysis contributes to this evaluation by providing frameworks and methods designed to approach the question of assigning value to these different outcomes of interest so that their relative 'worth' may be compared. A primary conceptual stress in conventional economic thought applied to education is to aggregate outcomes of interest by assigning monetary value to certain educational system outcomes and thus compare educational alternatives by weighing their monetary benefits against their costs. An approach to this same question of aggregating outcome measures to a single index is also provided by economics, through the methods used in conventional economics to study individual choice. Below we discuss essential features of each of these two contributions to educational evaluation.

From effects to benefits

The key problem of cost-benefit analysis is to translate the alternative educational system outcomes under consideration into measures that can be compared directly with costs, so that the question, 'Is this activity worth devoting these resources to it?' can be answered. The connections necessary to answer this question have been derived over the past two centuries (dating primarily from Adam Smith's, *The Wealth of Nations*, in 1776) by economists concerned with the operation of a capitalist economy, or the operation of a socialist economy according to competitive market principles.

According to this version of economic theory (there are others, which will be briefly discussed below), in a perfectly competitive market system the private sector of the economy produces those goods and services most valued by consumers in that society and, in so doing, utilizes the nation's resources as efficiently as possible. One of the principal reasons for this supposed state of affairs is that businesses are hypothesized to maximize profits (other necessary behavioural assumptions of the system are detailed in any standard microeconomics text, e.g. Henderson and Wuandt, 1958). The maximization of profits reflects a situation where the inputs utilized by a firm are priced on the market and, additionally, the outputs they produce are priced on the market.

If market prices truly represent social value (see Jamison, Klees, and Wells', 1976, discussion of shadow prices), profits in this theoretical system represent a signal to the producer that the output they produce is more valuable to society than the societal resources that are utilized in the production process.

Regardless of the extent to which this perfectly competitive world reflects fact or fantasy, one concern that has grown out of this system of thinking resolves around the means by which the public sector can make wise investment decisions. The private sector theoretically has profits to guide it as indicated above. However, public-sector investments often involve the production of goods or services which are not directly marketed. How should a nation's government decide which alternatives before it are most socially valuable? The methodological procedure devised by economics to answer this question is cost-benefit analysis.

Cost-benefit analysis involves the valuation of the outcomes of public sector investment in monetary terms and the comparison of these benefits with the cost of the investment. Just as profits are a guide for the private sector, cost-benefit analysis provides a criterion of social worth for investment decisions, again given that prices truly reflect social value. The trick, of course, is to translate public-sector investment outcomes, which are not directly marketed, into some monetary value equivalent.

In educational system evaluation, most economists have taken the approach that although outcomes of interest are not measured in monetary terms, they can be translated, at least in part, into monetary outcomes since the main 'products' of educational services, the students, enter the labour market. The hypothesis made is that formal and non-formal educational experiences result in the embodiment of additional skills and traits in the individual, yielding 'human capital' that makes the educated individual more economically productive, and thus increases the general productive capacity of the economy, thereby contributing to economic growth. If this additional productivity due to schooling can be measured, then one can compare a measure of the societal benefit in monetary terms with that of societal costs in monetary terms for a particular educational endeavour. Unfortunately, economic productivity is not easily measurable and the alternative most economists choose to measure is income. The connection between the two is again based on competitive market theory; in a perfectly competitive economic system the wage an individual receives is equal to the productivity that he adds to the firm. If this connection holds (and it is far from clear that it does), then the additional income due to schooling is also a measure of the additional productivity due to schooling.

Empirically, economists have approached this cost-benefit evaluation of educational systems in four ways: through rate of return, production function, labour force planning, and social demand studies. Rate-of-return analysis yields measures of the individual and social return on investment in education by examining the relation of schooling to

earnings. Production function analysis attempts to establish a more direct connection between education and productivity. Labour force planning efforts use assumed relations between education and sectorial growth to yield guidelines for educational expansion. Social demand evaluation relies on the implicit value educational consumers place on educational services. All four approaches differ to some extent, and each has its relative limitations and strengths (e.g. see Blaug, 1970).

However, perhaps more critically, all of the above approaches rely on the assumptions of competitive market economic theory to yield the connections between educational outcomes and social value—chiefly that wages and prices reflect the value of social productivity. To the extent that there are significant problems with this particular economic theory, the utility of the above cost-benefit methodologies is uncertain.

We see two basic problems with competitive market theory. First, it is clear that no real economic system operates strictly according to the few, but rather stringent, assumptions of perfect competition—profit-maximizing producers, utility-maximizing consumers, no individual buyers or sellers able to affect prices, free entry and exit from the market, etc. The critical question is what happens when the behaviour of the system deviates from these assumptions. Some theoretical arguments (in particular that of the 'second best' solution—see Baumol, 1972, for a discussion of this) imply that when even small deviations from the assumptions of perfect competition occur, there is no saying whether the system operates at a state close to efficiency. Thus, prices and wages may not represent anything close to what a competitive market theorist would consider social value and hence the valuation of educational alternatives or any other investment decision by costs and benefits based on market prices will not automatically yield decisions that are socially wise.

A second quite important theoretical and empirical criticism of this system of thought has to do with the assumption that competitive market economic theory is in some sense almost 'value-free'. The primary value claim specifically acknowledged is that labelled consumer sovereignty: that is, consumer preferences should direct the allocation of resources in society. This may be considered a reasonably desirable property of a social system by many, but one crucial question is to determine where these preferences come from. Competitive market theory implicitly assumes that the formation and development of individual preferences is not related to the economic activities of the society. This is unlikely to be true—educational activities are a clear case in point (see Gintis, 1974, 1969). The question then arises of whose preferences, and at what point in time, will guide resource allocation decisions.

A related issue concerns the weighting of these consumer preferences that are guiding production decisions. How do these preferences become aggregated? The theory of perfect competition essentially yields the rule of 'one dollar, one vote'. The preferences of those who have the most

money exercise influence over what goods and services are produced by society in direct proportion to their greater wealth. To a large extent, competitive market theory ignores any such equity considerations.

These latter points raise questions that are difficult for cost-benefit analysis, as formulated at present, to deal with. The economist's concept of 'society' as some abstract entity that receives all the benefits and incurs all the costs of any particular investment activity is called into doubt—first, because 'society' as an aggregate of individuals has different preferences at different points in time that are affected by its earlier resource allocation decisions; second, because 'society' consists of individuals and groups with unequal power and thus total benefits exceeding total costs will not necessarily prevent some individuals or groups from being hurt by a decision;[1] and third, in a more realistic view, because, given this unequal power, decisions may be made whereby the global benefits are inferior to the total costs as long as the costs are imposed on a group other than the group receiving the benefits.

The two problems discussed above, taken together, form a critique that questions the basis of most Western economic thought and consequently that of the cost-benefit analytic framework that is most commonly used. First, it is not clear that monetary values represent societal values and, second, it is not clear what 'society' as an aggregate concept really means.

Alternative economic viewpoints have been advanced, perhaps the most coherent centring around the works of Karl Marx and subsequent additions to the theories he initially expounded. Bowles and Gintis' (1975) *Schooling in Capitalist America* and Martin Carnoy's (1974) *Education as Cultural Imperialism* provide an application of such thought to the analysis of educational systems. A primary conclusion of this literature is that educational system changes cannot, by themselves, resolve any of the most pressing societal problems—e.g. inequities of wealth and power, widespread alienation, severe poverty in developing nations, etc.—but that what is needed is a basic restructuring of the national and international economic system (see Carnoy and Levin, 1976, for a good discussion of this point).

No definitive prescription for cost-benefit analysis comes out of Marxist thought (cost-benefit analysis in its broadest meaning is still sensible as it simply refers to a basic rationality in decision-making), nor do the criticisms of the competitive market model yield a clear solution to remedy its deficiencies as now applied. However, at least two general points do seem to emerge. First, one should be as much concerned

1. In theory, it is assumed that if the total benefits exceed the total costs of any activity, then that activity should be undertaken since those individuals who might be disadvantaged by the activity could be compensated and thus all persons would benefit, or at least not be hurt. In practice, such compensation is usually unlikely to occur.

about cost and benefits to different individuals and groups of individuals as about costs and benefits to the 'society' as a whole. Second, less concern should be directed to translating educational outcomes into monetary units. Alternative conceptions of development and economic progress can perhaps yield outcome measures that consider a wide range of social effects, incorporating impacts on equity, balance of payments, local or national autonomy, leadership, and other areas of societal interest. However, multiple outcomes in different metrics brings us back to the question posed earlier of aggregating different effects within a cost-effectiveness framework.

Alternative aggregations of outcomes

Apart from an extensively developed framework that covers questions of social efficiency, economists also bring a set of technical approaches to combining multiple educational outcomes or outcomes that occur over a period longer than one year. As most commonly utilized, cost-effectiveness analysis does not go beyond the stage of determining the impact of alternative strategies on the criteria of interest. It is left to the decision-maker to evaluate implicitly the overall worth of each alternative, presuming that no one alternative automatically dominates, and then make her/his decision. However, from the point of view of encouraging the decision-maker to think through the effectiveness trade-off more carefully and to allow these trade-offs to be scrutinized by other decision-makers and public interest groups, it can be useful to employ techniques which bring out these trade-offs explicitly.

Economists would examine outcomes (and costs) over time from the perspective that positively valued outcomes occurring in the present are valued more by the individual and the society than if the same outcomes were to accrue at some time in the future (and that dollars spent today are worth more than the same amount in the future). To the extent that this is true, if different educational strategies have a different incidence of effects (and/or costs) over time, they may be valued quite differently, even if they have similar effects (and/or costs) in the aggregate. Jamison, Klees, and Wells (1976) detail a method for looking at the average cost of a project (a cost-*effectiveness* measure really, not a cost measure, with students or views enrolled or graduated as the outcome measure) that discounts the time pattern of student enrolment by a social interest rate, while Klees and Wells (1977) discuss the same concept in a more general cost-effectiveness framework. A significant problem is choosing an appropriate discount rate.

There are alternative methodological means of aggregating several outcome measures (see Easton, 1974). Generally, such methods involve having the decision-maker convert all outcome measures to a common numerical scale with interval properties and then assigning relative weights to each equally scaled outcome measure. Two of the more

serious limitations of this technique for treating multiple effectiveness criteria are: the reliance on the subjective value judgements of the decision-makers and the potential effect of ignored criteria on the decision. Economists tend to prefer transformations to monetary amounts because of the alleged objectivity of the price system. However, there is nothing inherently wrong with subjective judgements, and there may be no escape from them anyway, as we discussed previously. The difficulty is that the decision-maker must somehow judge the relative worth of change in different criteria. Pessemier (1966) describes a technique similar to that above, but which attempts to transform outcomes to a monetary metric in which the decision-maker asks such questions as: 'How much more money would I be willing to spend to achieve the following change in the criterion of *X*?' Perhaps more development along these lines would be helpful.

The second limitation in some senses is even more serious. As the analytic difficulty increases with the number of criteria chosen for analysis, the decision-maker utilizing the technique described will eliminate many criteria from consideration. It is important that this elimination be of the criteria which are considered less valued, rather than those criteria which are difficult to analyse. Furthermore, it is important to be rather comprehensive in the initial conception of what effectiveness criteria are relevant to this decision, especially taking into consideration effects that may be unintended but socially valuable and none the less detrimental.

Relating inputs to outputs

In the discussion of how an economist looks at educational outcome measures, we have ignored the critical question of translating system inputs into system outputs. In the first section, we discussed a theoretical framework (see Klees and Wells, 1977, for a detailed analysis of efficiency concepts) that economists bring to educational evaluation in the form of cost-effectiveness and cost-benefit analysis—efficiency in the sense of allocating resources to those activities whose value is somehow judged to exceed their cost (either through aggregation by prices or by decision-maker judgements). We also discussed some of the more significant problems in making such efficiency judgements, even if information about the costs and outcomes of alternative educational strategies were available. In this section, we look at the question of whether, even assuming the efficiency framework of most economists to be a reasonable one, the empirical investigation techniques currently available to social science are capable of shedding light on causal input-output relationships.

The economists' approaches to both cost-effectiveness and cost-benefit analysis require an answer to such questions as: How do edu-

cational resources affect educational outcomes of interest, e.g. cognitive achievement of various types? How much of income differences between individuals are actually caused by differences in education? How much of the productivity differences between workers or farmers with different educational levels are actually caused by those educational differences? What specifically does education do to bring about existing income or productivity differences? How does consumer demand for education react to changes in the price of that education? The classic scientific response to questions of impact (that is, to questions of causality), the experiment, is often politically or practically difficult to accomplish with much rigour and the assignment of cause to some broad 'black box' treatment labelled 'education' or 'new educational strategy' is usually somewhat ambiguous. This is due, in part, to a growing concern for practical (as opposed to statistical—see discussion below) significance which brings even the proper form of the experiment into question (e.g. whether to use identical budgets, identical materials, or design the best pedagogical strategy for each educational alternative).

The lack of possibilities for structuring what science considers rigorous experimental tests to examine the impact of education, or of alternative forms of education, has led many social scientists to embrace recently developed statistical methods to analyse non-experimental information collected 'in the field'. The growing literature on educational production functions, educational demand functions, earnings functions, and agricultural and manufacturing production functions, attest to the dominance of regression analysis as the principal method for such empirical investigations.

For regression analysis (or its related methods—for example, analysis of variance, partial correlation analysis, or path analysis) to generate accurate answers to these questions, at least three principal conditions must be met. There must be a theory that specifies a complete causal model, one that includes all the relevant causal variables. The concepts one is trying to relate must be quantified and, moreover, quantified in a fairly rigorous manner, so that differences between variable values are meaningful (i.e. an interval scale—many commonly used variables do not meet this test; for example, occupational status or socio-economic status). Finally, this theory must indicate exactly in what manner these variables are related to each other (linearly, exponentially, logarithmically, etc.).

It is likely that the above conditions will not hold in answering any of the previous questions raised. For example, the theory as to exactly why and how achievement or earnings differ from individual to individual is weak at best and offers little basis for selecting other than a grab-bag of variables and using a linear functional form (see Bowles, 1970, and Psacharoparlos, 1974, for a review of educational production literature and earnings function literature). Our knowledge of production relationships in manufacturing and agriculture may be somewhat better,

but not much. The theory as to exactly how and why consumer demand for any good is influenced is also not very refined. In all cases, our ability to rigorously quantify the conceptual variables we do consider theoretically important is inadequate.

To the extent that the conditions necessary for regression analysis techniques to give an accurate portrayal of causal relationships are not met, the question that follows is how inaccurate will the results be? There does not seem to be a clear-cut answer to this, even in theory. There seems to be a tacit agreement among most social scientists to place less faith in the magnitude of the regression coefficients than in their sign. That is, all that is usually claimed is that one variable has a positive or negative influence (as opposed to no influence) on a dependent variable of interest, as opposed to claiming that a one-unit change in one variable will cause x units of change in the dependent variable of interest. Unfortunately, it is this latter claim that is necessary for estimating the benefits of educational investments. Furthermore, some of the problems with regression analysis may lead one to doubt if even the sign of a variable's coefficient is correct, which may explain why the results of educational production function analyses in the past have frequently been inconsistent.

None the less, the above considerations notwithstanding, we cannot make a decision without either assuming or determining something about 'causal relationships'. Rational decision-making rests on comparing the projected costs and consequences of possible alternative strategies of action. The relevant question then becomes, do quantitative empirical investigations of relationships add something to our individual or collective common-sense judgements?[1] Most social scientists would clearly answer this question affirmatively; the expectation is that replication of studies on different samples has to some extent yielded and will in the future yield some generalizable, consistent results that can serve to

1. There does exist a growing body of literature that is asking these types of question. For example, Crain and York (1976) question the efficacy of field study methods over experimental methods, even for large-scale social programmes. However, even the utility of the experiment is questionable. Starr (1974), in an article that looks at 'the edge of social science', discusses the 'ideology of the hedgehogs in social science', who never deviate from a straight and narrow, but distorted (according to Starr), view of empirical science. A view that allows quantitative 'data', 'like the shadows in Plato's cave . . . [to] become more real than the world itself'.

'The repudiation of other forms of discourse, the neglect of validity in pursuit of reliability; the reification of data as things-in-themselves, the illusion of false precision, these are not by any means necessary aspects of empirical science. But they are frequent enough to warrant mention'. (p. 410)

Cohen and Garet (1975) and Phillips (1974) discuss similar problems and also call for new forms of discourse (ones that recognize other forms of observation and evidence than that provided by significant coefficients) among researchers, as well as between researchers and policy-makers. Cohen and Garet suggest funding competing political views to undertake the same evaluation.

inform decisions. The principal caution, given the methodological problems above, is that common sense, experience, and judgement be used to interpret such quantitative findings. Still, the above considerations merit more debate on these points.

Concluding remarks

There are a few important points related to the previous discussion that should be mentioned and a few tentative conclusions that should be drawn out of the total analysis. Again, these points are relevant to educational evaluation in general; for a more focused discussion of the applications of these concepts to instructional technology evaluations see Klees and Wells (1977, especially Sections II and IV-D).

First, an obvious difficulty with both cost-effectiveness and cost-benefit analysis as usually practised is the bias towards those criteria that are most easily quantifiable. This bias leads to a failure to consider outcomes, such as social integration or social equity, that may be valued but for which outcomes the decision-maker finds it difficult to discriminate among the effects of various alternatives. It should be recognized that these economic frameworks do not necessarily, in their broad sense, require quantification—they only require that the decision-maker *conceive* of his/her decision in terms of a comparative weighing of the costs and effects or benefits of alternative policy strategies. It should be noted also that the development of techniques to quantify nebulous concepts and incorporate them into a decision analysis framework (e.g. see Pessemier, 1966) may be fruitful.

Second, even given the penchant towards quantification, there appears to be undue emphasis on cognitive outcome assessment. It is usually implicitly assumed that the learning of cognitive skills is the chief mechanism by which education contributes to individual and societal productivity. However, a number of writers have recently suggested and presented evidence to support the possibility that there are affective and/or certification effects of the schooling process that may be more relevant to employment and productivity than cognitive skills.

Gintis (1971) argues that economic benefits are due to the schools' role in forming work attitudes necessary to production. Furthermore, Gintis argues that these attitudes basically conform to a hierarchical mode of capitalist production—punctuality, obedience to authority, and lack of creativity for those destined for lower-rung positions and limited creativity and discretion within a framework of working primarily for extrinsic rewards for those going to higher level positions (see Bowles and Gintis, 1976, for a discussion). Arrow (1973) and Spence (1973) posit that the education process may actually have little or no value in developing economically productive capabilities in individuals, and may serve only

as a filtering mechanism that allows those who already have greater productive ability and motivation to pass through and be more readily identified by employers. Berg also argues that the school is primarily a certification mechanism, but goes on to suggest that even the labelling process may not have any economic worth because employers engage in conspicuous consumption of school graduates (that is, employers are willing to pay higher wages to graduates than to non-graduates even though the former may not be any more productive than latter). If Arrow, Spence, Berg, or Gintis are essentially correct, the stress on cognitive outcomes as a measure of educational project success has perhaps been vastly overemphasized.

Third, throughout this paper we have emphasized the analysis and effectively ignored the analysts. Carnoy and Levin (1975), in an article which is directly focused on research efforts related to the economic analysis of instructional technology alternatives (but which has wider application) spend a considerable amount of energy looking at the potential effects of who is doing the analysis. In particular, they apply the first 'law' formulated by James Q. Wilson (1973) in his article about policy evaluation:

> First law: All policy interventions in social problems produce the intended effect—*if* the research is carried out by those implementing the policy or their friends. (Carnoy and Levin, 1975, p. 387)

Carnoy and Levin argue that much of the research undertaken to evaluate instructional technology alternatives is sponsored by agencies that have a vested interest in the technology projects themselves. They hypothesize that these agencies choose researchers who often have an implicit bias in favour of the technology and tend to structure the evaluation so as to give the 'benefit of the doubt' to the technology alternative. To the extent that this is true and that such biases markedly affect the results of an analysis, this is clearly a very serious concern.

Carnoy and Levin, in the same article, also acknowledge that Wilson's (1973) second 'law' may apply to them since this 'law' states:

> Second law: No policy intervention in social problems produces the intended effect—*if* the research is carried out by independent third parties, especially those skeptical of the policy. (p. 387)

Both of Wilson's 'laws' together raise the same two essential questions that have come out of the total analysis above. First, as regards conventional economic analysis, is competitive market theory a reasonable framework on which to base educational analysis, or is it simply a reflection of ideological prejudices? Second, how much can the empirical methods available to social science discriminate among competing cause-effect hypotheses about how the world actually works? Our intention is not to berate social science nor to despair of progress. Our intention is to

stimulate discussion of what we consider to be the most basic issues of economic analysis applied to educational evaluation.

Two tentative strategies may be suggested in the light of our consideration of the two questions above (in addition to our recommendations earlier to look at costs and benefits for different population groups and to be concerned with developing a wider array of effectiveness measures than those currently being studied). First, research activities should perhaps be carried on and utilized at a much more micro level than is now the case. That is, part of the reason for insignificant or inconsistent research results may be caused by attempts to generalize relationships that are simply not generalizable. For example, the factors that most affect learning within one particular school environment may not be relevant to another. If this is true, it would imply that both decision-making power and research and decision analysis capabilities should be much more decentralized than they are now.

Second, we should be aware that most social science today (the common approaches to cost-effectiveness and cost-benefit analysis are no exception) emphasizes the effects of the characteristics of aggregate individual actors and often ignores totally the influence exercised by the properties of a particular structural system. As an example, a great deal of effort has been expended via educational production functions to examine the characteristics of students and teachers that affect cognitive learning. However, the major policy variable which will affect student cognitive learning is probably the choice of a curriculum. The 'no significant difference' finding in the literature comparing alternative instructional technologies indirectly supports this view. Walker and Schaffarzick (1974), in reviewing the empirics of the curriculum theory literature, stress the common-sense conclusions that if subject-matter is included in the curriculum (instead of being excluded from it) students will learn it better, and the more it is emphasized the better it is learned. While this may seem trivial at first, it is likely that the greatest policy leverage that we have over what is learned is via what is included and emphasized in both the overt *and* the hidden curriculum. Consequently, the investigation of those structural properties of an educational and socio-economic system that determine the nation's curriculum should deserve at the very least equal weight with research directed toward the effects of differences between individual characteristics within that structural system. This same point can be applied to almost any facet of social science research in general, and to educational research in particular.

Finally, we should recognize that there exist competing descriptions of the social reality we live in, and that our discussion indicates that the analysis of system costs, effects and benefits depends in part on the description of the work we choose. The distinction between decisions made for 'political' reasons and those made for reasons of 'economic rationality' may be less a distinction on the basis of rational decision-making (for both may or may not be rational), than a distinction along

the lines of what specific goals are being sought after, how one evaluates benefits divided among competing interest groups and, in general, who has what degree of control of the relevant decision-making power. Economic analysis is most useful to the extent that it makes decision-makers more aware and more explicit about alternatives and their various consequences. Once again, however, such analysis should not be taken as definitive, but as informative, to be interpreted with caution and common sense, based on the knowledge of both its strengths and weaknesses.

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Understanding 'success' in communication technology: a review of some Third World projects

Emile G. McAnany

The setting of the problem

There are a number of ways to define success and therein lies the critical problem with evaluation. Whose criteria shall we use when measuring success in such major social interventions as education, health or nutrition? Judgement is no longer only the domain of politicians but of researchers who have attempted through the development of a scientific discipline called evaluation to render these judgements of success or failure more 'rational' and 'objective', not to say 'value-free'. The heart of the dilemma is that all social interventions are based on values and that the evaluator's choice of criteria for success or failure reflect certain social and political values.

I was originally asked to provide an overview of the evaluation results of a non-economic kind for the application of communication or

educational technology[1] in Third World countries. Although I accepted this invitation, I have preferred to attempt a more modest undertaking.[2] The theme I have chosen to address concerns the factors which contribute to success and failure in technology projects in Third World countries. It is the contention of this paper that the successful application and significant deployment of communication technology in formal and non-formal education[3] depends more on the contextual or structural factors of the particular setting than on the planning and design factors.

The latter have been given increasing attention in the policy literature because professional planners either do not seem to realize how these contextual factors influence the outcomes of even the best designed projects, or, when they do recognize them, feel incapable of changing them (Mayo and Spain, 1977; Handcock, 1978). Likewise, evaluators often concentrate on the internal efficiency of a project and judge its success by criteria related to this rather than by the longer-term external goals that are most influenced by structural factors.

Success in the evaluation literature can be defined in two ways: (a) the achievement of defined project goals or, (b) the positive consequences of the intervention, whether defined or not. The latter have often been given the unfortunate name of 'unintended' effects which introduces the whole problem of intentionality into the definition of objectives. (The problem of bias this raises has caused one well-known evaluator, Michael Scriven (1973), to redefine the evaluation undertaking as 'goal-free' in order to avoid trying to figure out what planners intended and looking at what the intervention has produced.) Regardless of whether we agree or disagree with Scriven's approach, we need to pay serious attention to outcomes and not to tie them too closely to stated objectives which may or may not remain constant over time or reflect the entire gamut of effort that a project has undertaken.

A careful distinction between what economists have called external efficiency and internal efficiency is called for in analysing a project's outcome. This is roughly equivalent to what some evaluators (Suchman, 1967) have called the long- and short-term objectives of a project. To illustrate, an educational technology project using radio may be highly successful in training rural school children to learn mathematics but the graduates of rural primary schools may have no greater opportunity for

1. Although there are purists in education and communication who disagree, I use the two terms 'communication technology' and 'education technology' interchangeably. I include not only hardware and software in these terms but the planning analysis and method of applying the technology as well.
2. Evidence of this nature can be found in various sources cited in the references of this paper, but some specific ones are Schramm (1977); Spain, Jamison and McAnany (1977); Jamison and McAnany (1978); AED (1977); Audecam (1975); Mayo, Hornik and McAnany (1976); Mayo, McAnany and Klees (1975).
3. This would include regular school subjects and literacy as well as programmes in health, family planning, nutrition and agriculture.

employment than before. The system is internally efficient in teaching mathematics and indirectly helps the flow-through rate, but externally it is not successful. A grade school diploma does not benefit the rural student who has earned it.

In the subsequent examination of some recent technology projects, I wish to review the planning and implementation stages to discover what factors both internal and especially external, seem most to constrain the achievement of benefits. On the basis of this examination, I wish to indicate some policy implications for the future planning and evaluation of communication and educational technology.

Complicating factors for success and failure

Objectives

Before considering some recent technology projects, we need to begin with discussing objectives. As I have mentioned before, objectives are a slippery reality. One of the common problems evaluators face is that of trying to define clear objectives for projects they wish to evaluate.

The problems with objectives are multiple. First, objectives are not as a rule clearly defined and the imposition of clarity by the evaluator distorts the reality of what is happening in the intervention, if not what is going on in the head of a project director. Secondly, objectives change over time and should do so as the project adjusts itself to the reality of the context. Thirdly, the promoter of the project sells his or her idea on a political or long-range criterion and the implementors and evaluators often concentrate on a short-term educational goal. For example, the television programme *Sesame Street* was sold to the United States. Congress as a way of reducing learning gaps between minorities and the middle class, but once funding was procured, the shorter-term educational goals of 'everyone's' learning (with, naturally, the middle class learning more) were emphasized (Cook *et al.*, 1975).

A fourth problem about objectives is related to the third but is more complex: projects have implicit as well as explicit consequences and these are not necessarily in the 'intention' of the project planners. If consequences are defined as good, they are called objectives, if they are not defined as good, they are called 'unintended' effects. It is taken for granted that no bad consequences or social costs are intended and, therefore, these outcomes are often called 'side-effects' to indicate that only good effects are the 'intended' ones. Now, as we all know, a benefit depends on who defines it as a benefit.

And herein lies the complexity of outcome evaluation or benefit measurement. What is good for one person may not be good for another. An illustration may help: an educational technology project is intended

to provide primary equivalency education to rural drop-outs. The project 'succeeds' in training 15 per cent of this group at a low cost and with reasonable efficiency. As a consequence, the graduates all migrate to the urban areas to continue school or look for jobs. The individuals may gain but the rural area may lose an asset. *No one 'intended' the migration away from the* rural areas; in fact, there may have been an explicit objective that primary schooling would help make students more productive farmers. Thus the net loss of the best people to the rural areas is a 'side-effect' or 'unintended' outcome. But defined or not, it was inherent in the context of the project and it may have even been intended by a central planner who saw the need of more qualified labour for the modern sector. Then we have a conflict of objectives and of outcomes and are squarely faced with the dilemma of evaluation, in determining whether a project is a success or a failure. Should we judge the project by how it benefited the urban or the rural sector? Benefit alone should not be a criterion of success; the question needs to be asked, who benefits? Success for the urban sector may be at the expense of the rural sector.

Equity, or who benefits?

Questions of equity have made the work of evaluation more difficult over the last decade. Development theory during this period has begun to emphasize distribution as well as growth (Chenery *et al.*, 1974) and communication research has begun to examine not only how much information diffuses among rural people but also whom this benefits (Rogers, 1976, McAnany, 1978). Many bilateral and multilateral aid institutions have adopted a conscious policy of directing their grants and loans at the poor majorities in the least-developed countries and equity has become a major objective of programmes and therefore a criterion of success.

Evaluation, if it is properly done, involves several problems in the face of this drive toward equity. First, it should be applied to a project at an early stage when objectives are being discussed, and one of its tasks may well be to examine the assumptions that are implicit in project plans. For example, many rural radio projects try to programme information for farmers of small-scale farming in order to help increase the productivity of their yields. There is an assumption that increased information can help improve yield for these farmers. But it may be that although the intention is good, the increase in information alone has no significant impact on yield and income unless coupled with increased investments (Contreras, 1979; O'Sullivan, 1978). If an evaluator knew this before the project began, he or she might suggest that only farmers of large-scale farming would benefit from such a programme. Should the evaluator suggest abandoning a programme that would benefit somewhat 'larger' landowners (say from 2 to 5 hectares) and not the 'smallest' farmers? It depends on how one defines the criterion of success and who benefits. Or a project has already been implemented, how does an evalu-

ator decide which farmers to call 'small', and how to set the criterion for success? And should the evaluator, for example, point out that in the area 30 or 40 per cent of the population consists of landless labourers who benefit not at all from the project?

The more difficult and challenging task for the evaluator, however, is not in defining assumptions of projects or even in measuring a range of outcomes but in explaining *why* the results turned out as they did. This is what Suchman (1967) called 'process evaluation' or the examination of those factors that help explain why a project succeeds or fails. As he points out, we are most often interested in why a project does *not* work in order to improve the current effort or improve planning for future projects.

I would like to spend some time examining a few recent projects to point out what factors (whether planned or not) significantly influenced the outcomes of those projects.

'Successful' projects

According to the thesis proposed above, the factors that account most for the successful application and widespread use of technology in Third World countries are contextual and not planning ones. Let us examine briefly some examples of what are generally considered 'successful' uses of communication to test the viability of the assertion and to identify and discuss some of these factors.

Development communication

In the area of development communication, the Tanzanian radio study campaigns (1969–75) are widely agreed to have been 'successful'. The basic criterion of success in this case is sheer size. Beginning with only a few hundred people, by 1973 the campaign on health involved about 1.5 to 2 million adults. The evaluation of this campaign (Hall and Dodds, 1977) suggested that not only did audiences participate in weekly discussion meetings but also learned about health practices and participated in actions, including the digging of 750,000 latrines. A second example of a successful experiment in communication for development is the Basic Village Education project now concluding its work in Guatemala. Radio messages, sometimes complemented by a monitor for discussions and sometimes by an agronomist as well, seem to have influenced 'small' farmers in an eastern province of the country to adopt significantly more innovative agricultural practices and hence to increase productivity as compared to a control group of farmers (AED, 1977).

Improving quality in formal school

The use of educational media to improve the quality of instruction within the formal school setting can be illustrated by two examples, the El Salvador instructional television (ITV) system (Mayo, Hornik and

McAnany, 1976) and the Radio Mathematics Project of Nicaragua (Suppes, Searle and Friend, 1978). In the first, a national educational reform adopted television as the centrepiece for change in curriculum, supervision, administration, etc., for grades 7–9. Subsequent evaluation indicated an improvement in general ability skills attributable to television and a 'catalytic' effect of television in promoting system changes. The Radio Mathematics Project is a pilot test of mathematics teaching by radio in a rural province of Nicaragua using daily thirty-minute radio programmes with active student responses. Results show large and significant gains of experimental over control students.

Extension of schooling or distance learning

In regard to the extension of schooling to populations without opportunities for enrolling in regular schools, three projects may illustrate what is often referred to as open or distance learning. The Mexican Telesecundaria was less 'open' and more structured than those projects that have modelled themselves after the British Open University, but it is an example of the extension of schooling. It provided classes for students in grades 7–9, especially in the rural areas, where no regular secondary schooling was available. This was accomplished through television carrying the major instructional tasks with accompanying texts and a primary teacher as a class monitor. Results of an evaluation (Mayo, McAnany and Klees, 1975) showed Telesecundaria students doing equally as well as regular secondary students in a system that cost less than the traditional one. The Santa María Radio School in the Dominican Republic is a national primary equivalency system based on a distance learning model (individual radio reception, written assignments, weekly tutorial meetings with a teacher, etc.) that has enrolled about 20,000 students and graduated about 11,000 or 12,000 a year (1972–75). According to the results of an evaluation (White, 1976), Radio Santa María provides rural youth with an education equivalent, or superior to, traditional means and at a cheaper cost. A final example, which I draw from a series of distance learning studies being sponsored by IBRD, but not yet published (Perraton, 1978), is the Republic of Korean's Air Correspondence High School. In this project, senior high-school students study by radio, printed texts and correspondence. This provides about 22,000 students with an opportunity of finishing a high-school degree while working. The preliminary results (Lee, Futagami, Braithwaite, 1978) are encouraging in terms of efficiency and cost considerations.

I have cited some generally known examples of 'successful' communication technology projects for the purpose of identifying the factors in these projects, at both planning and implementation stages, which seem most likely to have accounted for this success; and, secondly, determining which values were operating in the evaluator's criteria of success.

Factors contributing to success

Contextual factors

Let us begin with what seems so obvious that it is treated almost perfunctorily in the literature on development projects. This is the political commitment of a government to change and development. The commitment means certain priorities will be held and that choices will be made accordingly. Thus, for example, the Tanzanian Government chose to emphasize rural development over urban industrialization and the radio study campaigns which were geared to rural areas had full government backing and collaboration. But there is an added aspect of political commitment which is difficult to measure and which often does not enter into assessments of projects, namely, a kind of charismatic support that leadership can lend to the work of project personnel.

The Tanzanian radio study campaigns have been much quoted in development communication literature as being a model for other countries in dealing with their rural development needs. But the major difference between the United Republic of Tanzania and many other countries is that the former had an effective political commitment to rural development implying priority allocation of resources to such a purpose. When rural communication projects fail in other countries, at least one factor to examine is the extent to which the government is really committed to rural development. The primary factor which influences change in rural areas is a political commitment to that change, without which education and communication, however well planned, can only have a minimal impact. Cuba over the past fifteen years has almost totally eradicated many of the direct indicators of underdevelopment: severe malnutrition, illiteracy, poor health and large gaps between city and countryside. What this indicates is a governmental commitment to goals of better health and educational services for everyone and the allocation of resources to that purpose.

But we do not need to look at the total political commitment to fundamental change as evidenced in countries like Cuba and the United Republic of Tanzania. On a more limited level, this same commitment is often manifested in a leader who has enough political influence and charisma to get a project started and institutionalized before he or she leaves the project. Such a factor is often left unmentioned in evaluations because it cannot be neatly quantified and yet, in the political realities of projects, we recognize that it is a critical factor that helps projects succeed. We may mention the crucial role that Walter Beneke as Minister of Education played in the Salvadorian ITV project. President Nyerere of the United Republic of Tanzania accounts not a little for the enthusiastic response that almost two million persons gave to the radio campaigns of 1973 and 1975. The early years of the Mexican

Telesecundaria were much influenced by its founder and leader who managed through political influence to overcome opponents and get the project's secondary degrees recognized. Finally, one wonders to what degree the success of Radio Santa María is attributable to the vigorous leadership exerted by its director who not only brought efficiency and drive to the project, but a political shrewdness that allowed the private organization to get its primary degrees accepted officially.

Another set of factors that seems critical in explaining the success of some of these projects is the motivation of the target audience. The motivation and political mobilization of Tanzanian peasants have already been referred to. El Salvador built educational reform and an ITV system on the basis of people's expectations of, and demands for, more education. The distance learning examples in Mexico, the Dominican Republic and the Republic of Korea all tapped strong motivation to get further education. In the first two projects this education probably meant migrating to the city and finding a job; in the latter project it meant a rise in salary for young Korean workers. The projects, for the most part, did not have to create their own enthusiasm. They offered people something that seemed useful and they could build upon the base of widespread interest.

Planning factors

The factors mentioned thus far have been external or contextual ones, but we cannot overlook the influence of internal factors as well, such as the efficiency and planning capabilities of project personnel. The Korean and Dominican, as well as the Nicaraguan and Guatemalan, projects manifest a coherence and efficiency in planning and organization that undoubtedly contributed a great deal to their effectiveness. The organizational structure of each, however, shared an important common element: none was part of the large government bureaucracy that usually diminishes the efficiency of even well-planned projects. Radio Santa María was a church-related organization run by a remarkably efficient director working with a small central staff. The Republic of Korea's Air Correspondence High School was attached to a special R&D group in the Ministry of Education. The Nicaraguan Radio Mathematics Project and the Guatemalan Basic Village Education projects are experiments controlled by some highly qualified expatriates but not operating as yet as fully governmental agencies. The problem that confronts pilot projects such as the latter two is precisely the transition from an experimental to a fully operational stage.

A second element of planning that has contributed to the effectiveness of these projects is the attention paid to the content and the design of the messages. The Basic Village Education and Nicaraguan Mathematics Projects have devoted a significant proportion of their budgets to this aspect. The Guatemalan project first studied the agricultural cycle and adapted carefully researched radio messages to the changing needs

of farmers, from soil preparation through harvest. Radio Mathematics performed R&D research on each year of the curriculum through continuous feedback from students. The Air Correspondence High School in the Republic of Korea and El Salvador's ITV also put emphasis on careful content preparation but in a much less intensive form than the two experimental projects in Central America.

A final item that should be noted about the internal factors that were an element in the success of some of these programmes is the learning model that underlies them. Radio Santa María and the Radio Mathematics Projects have an active learning approach in which students respond to the radio message while it is being broadcast. There can be no doubt that this has contributed significantly to learning (Suppes, Searle and Friend, 1978; White, 1976). The United Republic of Tanzania's method in the discussions following radio broadcasts sought to promote the contribution of each member of the group to problem clarification and to downgrade the dominant role that the discussion leader often assumes. Evaluation showed an increase in farmers as discussion leaders over teachers in that role from 1971 to 1973, and a larger number of people contributing to the discussion in the group (Hall and Dodds, 1977).

We have discussed both contextual and planning factors that contribute to the success of seven technology projects. It is difficult, if not impossible, to sort out the exact amount of variance in the outcome variables attributable to these and to other factors. What is more important is to recognize that significant factors which may not be easily measurable do intervene significantly in the level of success or failure that we have measured with our traditional evaluation instruments.[1]

Criteria in judging 'success'

A point to be stressed is that, however scientific or objective our evaluation methodology may be, we constantly rely upon a value base, either our own or someone else's, in choosing the criteria by which to judge a project. The seven projects already discussed may be used as a basis for exploring this last point a little more deeply.

In a review of educational technology evaluations published several years ago, two critics were asked to comment on the findings of these studies (Carnoy and Levin, 1975). Their criticisms were that the evaluations were positively biased in two ways: (a) all of the evaluations were conducted by those in favour of educational technology or working for

1. Administrative histories, although not quantifiable, often help to illuminate how or why a project has performed in a particular way. Two examples from technology projects are Mayo and Mayo (1971) on El Salvador, and Grant (1977) on the Ivory Coast.

agencies thus inclined and gave a positive interpretation (or 'benefit of the doubt') to results; and (b) the evaluations narrowed the scope of study to items on the agenda of the sponsor. The critics admitted that, for their part, they were negatively biased toward educational technology and that, had they made the evaluations they would have found quite different results. Such an 'adversary' approach to evaluation may make some people uncomfortable, but it provides a healthy way of controlling bias in research and helps to enlarge the perspective from which technology is evaluated. Some of the concerns of these and other critics of technology will be explored briefly below.

One key point to clarify in discussing the outcome of technology projects is the extent to which we concentrate our evaluation on internal efficiency and effectiveness or on external efficiency and longer-term benefits. I have illustrated this point above and have explored it in more depth elsewhere (Lenglet and McAnany, 1977). I would argue that most of the judgements of success of the projects under discussion are based on shorter-term benefits of internal efficiency and not on longer term, external efficiency benefits. There are several reasons for this and several consequences which we shall explore in the subsequent pages.

It is clear that because of the fact that Basic Village Education and Radio Mathematics Projects are experiments, they are judged by a different set of criteria from other interventions. The problem they face is whether they can or will be expanded to operational systems. Although the criteria for the evaluation were rigorous and the evidence carefully gathered, the control exerted over the environment by implementers may prove, as with all experiments, the greatest obstacle to their translation into functioning systems. What the experiments seem to demonstrate is that under special circumstances radio *can* be used successfully to impart agricultural knowledge or teach mathematics but not that it *will* do so when more usual circumstances prevail and the context is able to exert a more typical influence on outcomes.

The El Salvador television project has been carefully evaluated (Mayo, Hornik and McAnany, 1976), but there are a number of other criteria that the evaluation did not take into consideration, which would mean qualifying the term 'success'. One argument raised by critics is that even though ITV in El Salvador achieved shorter-term learning goals, longer-term goals of the Educational Reform, such as providing more qualified labour for an expanding industrial sector, were not achieved. Another argument is that success must be judged in the long term when the initial enthusiasm has worn off and problems have had an opportunity to emerge. Finally, the longer term study of ITV in El Salvador might show its bureaucratization and increasing inefficiency and lack of flexibility (Werthein, 1977).

It might be thought desirable to study the Dominican Radio Santa María, not as White did, in comparison with traditional adult education, but for its effects on increasing the rural exodus. White's study suggests

that a large portion of Santa María students plan to leave the rural areas for the city at the end of the eighth grade. The same approach to the Telesecundaria in Mexico could be adopted in evaluating the outcomes of that school system. The efficiency of these two systems in producing graduates needs to be balanced against the social costs for the rural areas from which the best human resources are being drained.

The Air Correspondence High School in the Republic of Korea has not yet studied the effect of background characteristics on entrance to, or continuation with its courses. Such a study may well reveal that the project, although it provides further learning opportunities for some, does not do so for all who wish or demand it. It may only make a small contribution to a limited group and widen gaps with a much larger group who cannot take advantage of the opportunity.

Finally, the Tanzanian radio campaigns have been judged successful on the basis of the two most recent campaigns in 1973 and 1975. The influence of historical circumstances in promoting national enthusiasm may have contributed significantly to the wide participation. One would need to study several more campaigns to see whether the approach has been institutionalized enough to carry on in changing national circumstances before declaring the campaigns successful and certainly before asserting their usefulness for other countries with very different circumstances.

Critics lodge several arguments against technology and demand that it be judged by broader standards. They say that it is more costly than has been claimed; that it is a centralizing and controlling force in educating people according to the dominant ideology of the country and leaves the teacher as a mere adjunct with little freedom of action; that it does not solve the structural problems that plague most Third World countries; that the degrees from distance learning systems are not of equal value in obtaining jobs even if they may provide adequate cognitive skills; and, finally, that it creates the impression that something is being done for the poor while failing to deal with serious change (e.g. Arnove, 1976). They further argue that evaluations of technology projects choose criteria that do not take these elements into consideration.

What these objections call for is a widening of criteria by which technology is judged; for instance, the inclusion of criteria involving longer-term outcomes that have often been left unmeasured. In other cases we need to monitor carefully the impact of structural factors on even short-term outcomes (Contreras, 1979). In still other cases we need to admit that neither technology nor education is likely to change basic structural factors. Nevertheless, these factors need to be taken into consideration at the planning stages of projects so that more modest goals can be set and more realistic criteria for outcomes utilized.

Conclusions

What major conclusions may be drawn from the previous discussion? First, that we recognize all criteria to be based on an implicit or explicit set of values. As a consequence of choosing a set of criteria, the focus of attention in assessing outcomes will be restricted and exclude considerations of other possible costs and benefits. Second, that in the past we have judged too much by internal efficiency standards and not given sufficient attention to the longer range implications of educating people with technology. Third, that we have not yet paid sufficient attention to intervening contextual factors that both greatly affect short- and long-term outcomes and overshadow the effects of national planning and organizational efforts. However, the mitigation of these structural factors allows these planning and organizational efforts to make substantial contributions. Fourth, that equity as a criterion of success imposes a somewhat different set of criteria for benefits than those used in the past. Equity will also probably impose greater costs, since it is often more difficult to reach, educate and employ those whom society's structures have placed toward the bottom of the scale. Finally, returning to my basic thesis of the preponderance of contextual factors over planning factors, I do not wish to give the impression of a necessary contradiction between the two. Rather, I see the most successful application of communication or educational technology when both contextual and planning factors are favourable. Hence, I would suggest that a planning strategy be adopted to search for these contexts that promise the best results from an application of a rationally planned use of technology. We would thus avoid the irrational hope often manifested by planners, that technology alone can overcome the major social problems faced by a society. Rather we would be able to use the available technology to assist societies which have confronted these problems and are looking for a tool to help them.

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The role of values in economic analysis of education[1]

Kiran Karnik

'Development', said H. G. Wells, 'is a race between education and catastrophe.' Like much of his science fiction, the reality of this statement is also now dawning on us. There is increasing realization all over the world of the importance of education to development. What was once considered desirable and beneficial to the proper development of the individual's personality has now been recognized as a prerequisite of economic growth and national development. Education is thus considered as one of the inputs necessary for economic development; an economic commodity; or a process capable of 'adding value'.

With this education-development relationship in mind, most countries are spending increasing amounts—and even increasing proportions—of growing budgets on education. If almost all this money were to go into 'conventional' education—i.e. into the regular traditional school system—then the main worry would be how much of the national budget should go into education. A decision on this would involve some economic analyses, but would be fairly straightforward if appropriate boundary conditions were clearly stated. However, the limitations of the traditional system are becoming increasingly obvious, especially in a situation involving rapid expansion of education and educational opportunities.

For example, consider the present situation in India; literacy has increased from about 17 to 30 per cent in the last two decades, while the number of primary school children has gone up tremendously—from under 20 million in 1950–51 to over 60 million now. Undeniably, this is good progress. But is it enough? Let us for a moment look at the problem of literacy, not in percentages but in human terms. In 1950–51, just under 300 million Indians were illiterate. The figure now is about 400 million. Thus, in the last quarter century, we have added 100 million illiterates or over 10,000 illiterates every day. Free and compulsory elementary education up to the age of 14 is a Directive Principle of our Constitution. This, however, remains a dream even thirty years after independence.

The qualitative aspect of the problem—though more difficult to define—is certainly far worse. In 1965–66, 50 per cent of the lower primary school teachers and 40 per cent of the higher primary teachers had not even matriculated. The position has not altered radically since. The effect

1. Paper prepared for keynote speech for the ICEM/EDUTEL Conference on Economic Analysis of Educational Media, 2–4 March 1977, Washington, D.C.

of these underqualified, untrained teachers on the educational system is not only bad education, but an unfair imbalance of opportunity—the privileged few (in urban areas, of course, where all privileges reside) getting the benefit of the handful of well-qualified and good teachers.

Almost all developing countries which have placed greater emphasis on traditional educational methods are in the same plight. Clearly, one has to think of new approaches and new strategies to tackle this immense problem. Fortunately, technology has provided the basic tools which can lead to a definite strategy. However, the best strategy will clearly vary from country to country and situation to situation. There is therefore a range of choices, a number of alternative approaches, strategies, media mix and so on. Evaluating these and then selecting the optimum one is the task of economic analysis. Cost-effectiveness and cost-benefit analyses are the two primary methods in use.

Both techniques involve the identification of all cost elements and some definable measure for the output or goal. Temporal differences (in terms of expenditure at particular periods of time) are provided with a common base by discounting—using the discounted cash flow method. Of crucial importance here is the assumed rate of discount. It is supposed to reflect the social cost of capital or the opportunity rate. Different rates can lead to different conclusions in terms of ranking alternatives. Operational details of these two methods are fairly well established and a large body of literature exists on them. Further details are therefore not discussed here.

For any proper analysis, it is clear that a definition of goals is the crucial starting-point. Goals can either be determined outside the system or can result from interaction within the system and an analysis of the alternatives. While allocation of funds to education is supposedly the result of a detailed input-output exercise for the economy as a whole and a projection of long-term needs, in reality one can safely assume the budget to be a given, fairly inflexible figure. It is therefore, necessary to conceive of a methodology to allocate this budget rationally to the various claimants. A reasonable division of end-use would be by type and level of education, i.e. non-formal, adult, pre-primary, secondary, high school, graduate level, post-graduate, doctoral, etc.

Allocation of funds between these different competing claims could—and should—be based partly on an analysis of the nation's manpower requirements. As an example, funds may have to be invested in setting up new engineering colleges if manpower requirements for the future indicate increased demand not capable of being met by existing engineering institutions. In such cases, given the definite objective of producing N-trained engineers within T years, one can most fruitfully use cost-effectiveness analysis to determine the optimal method or strategy for achieving this goal.

However, a considerable amount of the education budget is inevitably—and quite rightly—spent on the basis of very long-term anticipated

needs and on the basis of a philosophy or principle. An example of the latter is the stated desire in India to provide free and compulsory education for all up to the age of 14. At the same time, there are other competing demands, some rather pressing, e.g. adult literacy, others politically necessary (a university in each region of each state, etc.). What analytical tools can help objectively to determine relative priorities in such cases? Among the more commonly used techniques, there is little doubt that cost-benefit analysis is the best. It must, however, be noted that in spite of what economists might say about the methodology being objective (as engineers say about technology), there is little doubt that the results of a cost-benefit analysis depend to a large extent on the ideology or at least viewpoint of the analyst. This situation arises because, while most costs are amenable to objective quantification, benefits generally are not. What, for example, is the relative benefit of educating a city child as opposed to a rural child? Given a fixed sum of money, should it be invested in adult literacy or in pre-primary education? What is the social benefit of accelerating a given education programme so that it is completed in T—n instead of T months?

The quantification of such benefits is a highly subjective process and the results depend greatly on the analyst's viewpoint or philosophy. To take a concrete example, the investments made in the Satellite Instructional Television Experiment (SITE) for morning broadcasts to children could very definitely have covered a larger number of schoolchildren if the investments had been made in a city—Bombay, for example. Thus, a cost-benefit analyst using standard benefit indices such as cost per student per year, or a composite index such as cost per student per year for one hour of instructional programme, would prefer to cover schoolchildren in a large city.

The implicit assumptions of the analyst are that: (a) there is no differential benefit in reaching one group of students as against another; (b) the gain (however defined) is similar, on the average, in any group of students for a given exposure; (c) the quality of programmes is either irrelevant or an invariable factor; (d) the secondary impact on teachers or others is negligible.

The assumptions listed above are indicative and not exhaustive. The basic problem with this approach is that it does not even try to get at the real benefits; instead it uses the number of students as the primary benefit variable. Obviously, this approach has the advantage of simplicity and is of apparently universal applicability. But this is precisely the main danger: such simplistic, easy-to-use approaches tend to proliferate very fast and to be used for decision-making. It need hardly be pointed out that this methodology would result in heavily favouring precisely those pockets of affluence and privilege (and here we are particularly concerned with the point of view of developing countries, where such methodologies are adopted and used very quickly indeed) in urban areas which already have all the advantages. Thus, a seemingly innocuous methodology, used

blindly, would strengthen the status quo and make equity an even more distant dream. Even though those who evolved this methodology may not have intended it, we begin to see how techniques and methods tend to be value-loaded.

A 'neutral' analyst (if such an animal exists) inevitably *adds* to the value-orientation of the technique by applying it blindly. Any economic analysis must accordingly be based on a clearly enunciated philosophy or value system. Taking further some of the earlier issues and questions, and on the basis of a particular value system, one would like to take the following into consideration as part of the function that defines the benefit:

Gain in knowledge among students.
Increase in curiosity/questioning among students improvement in teachers' teaching ability.
Inequality ratio between the best schools and the schools chosen for analysis.
Ratio of average income of these students' families as compared to the national average.
Decrease in truancy.
Decrease in drop-out rate.
Improvement in the status and image of the teacher in the community.
Number of students who are actually exposed to the programme.
Number of hours of school programmes broadcast per day to the particular area concerned.
Relevance of programmes.
Percentage availability of set (i.e. in working order, switched on and power available) during broadcasting times.
Changes in the value system.

The listing is neither in order of importance nor exhaustive, but is intended to be indicative of the type of factors that may be considered as giving a particular philosophy or value orientation. Clearly, some of the factors would be irrelevant in some countries; this listing is mainly from the Indian perspective and in the context of television broadcasting to rural schoolchildren.

I have intentionally not touched on the costs, since a great deal of work has already been done with regard to cost analysis. Dealing with costs is somehow simpler and more straightforward than assessing and quantifying benefits. Of course here also there is the question of shadow prices or social opportunity costs—and areas where again one's values or philosophy play a part in arriving at figures. However, this whole aspect has been dealt with more extensively in research and in actual practice. I would therefore like to concentrate on the aspect of benefits.

The purpose of making the indicative list of benefit-indices is to highlight the kind of benefits which are often ignored, generally because they are difficult to quantify. And economists (and planners) like to deal only with variables which can be quantified. Certainly, many of the

variables indicated above would be difficult even to determine, but that is hardly a reason to ignore them or minimize their importance. An actual working of a cost-benefit analysis on the basis of the above is feasible, even if some benefits have to be left as statements and not quantified. An analysis of this type would indicate the relative advantages of concentrating on backward rural areas as opposed to urban areas. To the above must be added the time dimension; for example, the number of years saved in achieving a given objective by this approach as compared to the next best.

The factors listed clearly show a leaning towards rural areas and towards the deprived classes. This indicates the subjectivity of the cost-benefit approach in social areas and the consequent importance of having a commonly agreed philosophy or 'credo', on the basis of which the analyst establishes his point of view.

If the credo emphasizes reaching rural areas, taking education to those who need it most, establishing greater equality of educational opportunity and functional literacy, the cost-benefit ratios of alternative strategies can then be worked out for such goals. If time is also important (who would deny it, especially in a developing country?), then clearly the strategy must include components that provide quick, extensive coverage.

Such coverage can be achieved quickly only through broadcasting and—particularly in isolated and poorly developed areas—through satellite broadcasting. SITE already demonstrated this capability with great success. For example, the educational programme for children was viewed by about 150,000 children every morning and, while a specific evaluation of the impact of these programmes is still under way, it can confidently be asserted that these programmes have had at least limited success. However, no cost-benefit study has yet been carried out though a detailed cost analysis does exist.

While a detailed analysis must be made to prove this point, it can also be confidently claimed that a multimedia package assures the best cost-benefit ratios. An example is the highly successful teacher-training programme conducted during SITE (in November 1975) when about 24,000 primary school teachers were trained in science teaching. A similar exercise was carried out just before the end of SITE, in July 1976, and a similar number of teachers was reached. Detailed cost figures, impact assessments and other details for this are not immediately available, but a cost-benefit analysis based on the methodology and philosophy outlined earlier would be an interesting exercise. For the philosophy assumed here, preliminary investigations indicate that the optimum strategy would include satellite television as a major component. This could conceivably lead to the creation of a 'national educational grid'. However, any such national grids—or large-scale broadcasting for that matter—often have certain inherent disadvantages or negative by-products. It is the job of the methodology or of the cost-benefit analyst to ensure that such negative effects are also given due consideration in the analysis.

One possible danger is homogenization. Media—and television in particular—tend to standardize people's emotions, feelings and culture. This is bad enough generally, but particularly dangerous when it occurs in the process of education—for every school and university may then 'become the sausage machine which turns out people without any real culture and incapable of thinking for themselves but trained to fit into the economic system . . .'.[1] If education is to be the process by which a person is taught to think—*how* to think and not *what* to think—then such standardization is clearly unwelcome. Standardization and the media's role in shaping thought—in determining what to think—lead to a discouragement of diversity and to the perpetuation of one type of system. The 'freedom' of the individual is then constrained to remain within the boundaries of this system, as has been so convincingly argued by Marcuse and others.

In any educational strategy, educationists must guard against such tendencies. A sophisticated cost-benefit analyst would, in fact, begin to indicate the non-optimality of such systems—provided the input in terms of the philosophy (which, as was shown earlier, determine benefits) is appropriate. A cost-benefit analysis should, therefore, in this case indicate as benefits (and high benefits) such things as diversity (of thought and expression), decentralization, and increase in curiosity or inquisitiveness (e.g. among children, the propensity to ask more questions). After all, the process of education consists in teaching people to question the society they live in.

It is recognized that many factors are difficult not only to quantify, but even to identify. However, it is of crucial importance that, in trying to perfect a smooth and efficient model, the basic factors are not overlooked. In this regard, I would again like to emphasize the crucial role of national policy or philosophy in cost-benefit analysis. Any purely 'objective' analysis not informed with these considerations would be a sterile exercise.

Much of the effort and frustration involved in carrying out a cost-benefit analysis is related to the problem of quantifying benefits. The economist would ideally like to convert all costs and benefits to money terms, or to some single index. However, 'rational individuals' and a 'perfect market' exist only in textbooks. The process of decision-making (at least in most developing countries) is likewise not always determined by economic factors. Economists would do well to keep this in mind and not worry too much about trying to quantify everything. In fact, leaving some benefits merely as statements is often far more effective.

Another danger is the tendency of analysts to worry about the temporal element in costs only. All costs are carefully annualized and discounted using social rates of return worked out with great difficulty and

1. Gabriel Cohn-Bendit and Daniel Cohn-Bendit, *Obsolete Communism: The Left-wing Alternative*, New York, McGraw-Hill, 1968.

sophistication. However, the importance of time in relation to the benefits is often ignored. Is it not more beneficial that the individual be literate today rather than three years hence? With our immense problems which time only compounds (over 10,000 illiterates added every day in India, for example), we should do well to remember an old saying: 'Space we can recover, time never . . . I may lose a battle, but I shall never lose a minute.'

Measuring the effectiveness of instructional radio: the methodological issues

Howard P. Tuckman and Tewfik F. Nas

The main purpose of effectiveness analysis is to determine the extent to which a programme is successful in meeting its objectives as defined either by the organization concerned, its funding agency, its clientele, or the larger society to which it belongs. Effectiveness analysis provides a measure of what is accomplished by a project. It also offers an insight into how effectively the stated goals of the project are met. As we shall see, what is accomplished often differs from what the organization wishes to accomplish. This poses a problem in determining the criteria by which effectiveness is measured.

From an economist's perspective, the appropriate measure of the effectiveness of a project is the one that most closely captures the outputs which that project actually produces. The limits on what is termed an acceptable output are set by the scope of the analysis.[1] If the organization undertaking the evaluation is concerned with internal efficiency, the benefits should be limited to those which affect the organization itself.[2]

1. This corresponds to the treatment of the level of analysis common in cost-benefit studies. See, for example, R. N. McKean, *Efficiency in Government Through Systems Analysis with Emphasis on Water Resources Development*, New York, John Wiley, 1958.
2. A project evaluation based on the internal standards of the project's designers or of its current administrators provides a measure of efficiency, albeit an internal one. What is important is not whether social welfare is maximized in the aggregate but rather whether the project is meeting its internally defined goals. A difficulty with viewing a project from this perspective is that an effective project may none the less be one with no tangible impact on its participants. For example, a project with the stated goal of transmitting ten hours a day would be judged equally effective by this criterion whether 50 people or 50,000 listened. Likewise, a project designed to raise reading scores ten points would be judged equally successful whether people retained these skills or lost them.

If the study is to be used for comparative purposes, especially in comparisons across countries, the perspective should be a more global one.

No matter what the perspective of the analysis, the primary purpose of engaging in effectiveness analysis should be to compare effectiveness with cost.[1] Especially in developing countries where capital is scarce, it makes little sense to select the best project irrespective of cost. The efficient choice is the project with the highest effectiveness per dollar of project cost. Where project choice is made solely on the basis of effectiveness, the project designer implicitly decides to forgo efficiency as a criterion. This may be justified where the goal is to purchase the best project irrespective of cost. But relatively few developing countries can afford to make choices on this basis, at least at present.[2]

How quantitative a measure?

The above discussion implicitly assumes that the outcomes of an effectiveness study are sufficiently quantitative to permit comparison with similar projects elsewhere. In practice, studies of effectiveness run the gamut from the purely descriptive to the fairly mathematical.[3]

Purely descriptive studies are not usually useful in facilitating project comparisons. While such studies are inherently interesting, and while they serve to record the operations of a project at a moment in time, they rarely provide sufficient information to allow the decision-maker to decide whether project A will offer more benefits than B, or whether A is better for providing education in mathematics or animal husbandry. Descriptive studies provide information on an organization and its general effects on people. They serve best in an informative rather than a comparative context.

A multitude of quantitative output measures are available to measure effectiveness and we shall discuss some of these below. In many effectiveness studies, the presence of a number of output indices poses a problem. Where all the benefits can be denominated in dollars, social welfare is optimized by picking the project with the largest dollar yield per dollar

1. It is imperative that the scope of the benefit measures of a project coincide with the scope of the cost analysis. If an inclusive measure of costs is to be derived, the measures of effectiveness should be equally inclusive. If this procedure is not followed, an implicit bias is introduced into the data.
2. Such are the mechanics of the economic system that even those countries with windfall incomes from oil, such as Venezuela and Iran, have found that purchasing the best item irrespective of other constraints can lead to rapid inflation and to commodity shortages.
3. Compare, for example, the discussion of D. T. Jamison to that of Hudson in, *Radio for Education and Development: Case Studies*, edited by P. L. Spain, D. T. Jamison, and E. G. McAnany, Washington, D.C., IBRD, 1977.

of cost. The presence of a dollar denominator allows all benefits to be aggregated and eliminates the need for weights in aggregating and valuing outputs. When effectiveness is evaluated using test scores, responses to surveys, or other point score measures, this poses a problem in terms of evaluating the validity of alternative measures because the judgements as to how to aggregate the indices are subjective. It also makes comparisons across countries based on different indices virtually impossible.

An ideal study of effectiveness, descriptive or mathematical, should have at least four structural elements; (a) a well-defined set of outputs to be measured; (b) a predetermined strategy for evaluating the output measures; (c) a representative set of programme participants and; (d) an adequate control group against which the effects of an activity or set of activities can be measured. These elements are usually present in effectiveness studies in varying degrees. At issue is the question of how the absence of one or more of these affects the validity of cross-project comparisons.

Careful definition of the output set is important in measuring effectiveness. This can be undertaken by specifying a set of measures that would capture all of the major outputs of an educational project. However not all of these are known in advance. Thus, it is useful to begin with a pre-test or a set of case-studies to provide information on project benefits not recognized by planners.

Case-studies, an approach often favoured by anthropologists to evaluate programme impacts, provide the analysis with a depth that is often lacking in other approaches. The interviewer is able to focus attention on a single family or a limited number of families. Properly trained, he or she provides a detailed and comprehensive insight into a programme's effects that is often lacking when a project's outputs are measured through a less time-consuming method. The interviewer has the advantage of getting to know the family. This may breed trust and may also increase the reliability of the data. Especially in developing countries where distrust of outsiders and regional dialects hamper the flow of information, the case-study provides as reliable data as one is likely to obtain from on-site data-gathering.

What makes it difficult to use a case-study approach for effectiveness analysis is its limited representativeness. To be useful in project design, an effectiveness study should provide information that is applicable to the entire population the project serves, not simply to selected segments. While it is possible that a study of ten families may be reasonably representative, in the absence of suitable weighting procedures, the results obtained by this procedure are often not useful in choosing among projects. Differences in interviewer perceptions, the inability to weight the results to reflect the target audience, the failure to include representatives of all the various groups of listeners, and the inherent subjectivity of the output measures call into question the usefulness of case-studies for project selection purposes.

A related difficulty with the case-study is the absence of quantitative measures. The interviewer frequently records a set of impressions. There is a book in the house. A new latrine exists in the back. The family has a compost heap. These items can be used as quantitative indicators if all interviewers are told in advance to look for them. But their usefulness as effectiveness measures is limited.

Of crucial importance to effectiveness analysis is the presence of a meaningful control group. The best control is a group of persons who have not been exposed to either this learning activity or to suitable alternative sources of learning. Where a project is small and has been in existence for a short time, it is relatively easy to compare the learning levels or social progress of an 'affected' group with that of an 'unaffected' group. Where the project has been in existence for many years, as in the case of the Colombian radio schools, and/or where it is national in scope, it may be difficult to find an 'unaffected' control group.[1] There are several aspects of this problem which warrant study.

An educational project exists in a time dimension. Education takes time to deliver, time to absorb, and time to extinguish; its real effects are likely to be revealed only after a period of time. Presumably, the analyst should take timing into account in measuring effectiveness over the long term for the same reasons that we use a discount procedure to value costs. In the absence of concrete measures, such as the effect of education on earnings streams, the problem is how to capture these time effects.

A current measure of effectiveness takes into account the total learning that has gone on since the inception of a programme less the amount of learning that has been lost due to ageing, other physical factors, inability to reinforce earlier learning due to environmental constraints, etc. For a programme which has been in existence for a short time, this poses no serious problems. However, for the long-term project, say, one which has been in existence for ten years, it is difficult to interpret the meaning of a positive outcome. If it is viewed solely as the result of the current level of training being offered, then this implicitly assumes that the value of past training is zero. On the other hand, if it is the sum of the current education plus some discounted value of past experiences, what is the appropriate way to weight past and current learning to render them comparable? This problem is further compounded where an attempt is made to compute a cost-effectiveness ratio. At this point, the issue of the time duration of the effectiveness measure must be confronted directly.[2]

A related problem, which exists, in part, because time cannot be

1. This is particularly true for a project like Radio Santa María in Colombia which has been in existence for thirty years. The key problem is not that an unaffected group cannot be found but rather that it is difficult to know how a group is affected.
2. If the effectiveness measure captures the cumulative effects of a programme, then its cumulative cost should be used in the denominator in forming the ratio. The issue then arises as to how many years of cost are applicable.

held constant, is that some persons are exposed to other learning experiences than those of the project and these may have a substantial influence on the effectiveness of the project.

It is not the exposure to other educational experiences in itself but rather the difficulty of identifying these episodes that is important. Without proper identification of these exposures it is difficult to know the target against which the effectiveness of a programme is being judged. Ideally, it is possible to compare the participant group to those with no alternative education, or to those with a common level, i.e. three years in first-level schools.[1] But in many developing countries a variety of organizations exist to help people in rural areas. Some of these are sponsored by the government and some by private agencies. In both instances data on where rural programmes are currently under way (and where they were previously under way) can be extremely difficult to obtain. Under these circumstances, the opportunities for the researcher to obtain an acceptable control group may be severly limited.

The conceptual difficulty this raises can be illustrated using a relatively simple model of what determines the educational outputs absorbed by an individual at a point in time. Each symbol in equation 1 presents a vector of measures for each of the individuals affected by a particular project. For the sake of simplicity, the only notation used in the equation, t, denotes the time period.

$$O_t = F(O_{t-1}, E_t, V, U_t) \qquad (1)$$

O_t is the measured set of outcome for a project at time t, O_{t-1} is the measured set of outcomes from previous periods, E_t is the influence of the input mix employed by a project, V is the impact of all other context variables and U_t represents all other variables that cannot be identified.

In order to provide a measure for the effectiveness/cost ratio, as a first requirement, the incremental change in O_t due to the incremental change in E_t must be identified. This is not an easy task. If O_{t-1} cannot be isolated, the value of O_t will shift for reasons unrelated to the other variables. As a result, the effect of E_t estimated through this procedure will be biased. The same results will occur if the effects of the V variables are ignored.

This formulation provides what economists call a production function. With the appropriate specification of the programme outputs, defined either in terms of cognitive achievements or impact outcomes (such as a change in productivity or in the income of participants), the effects of an educational programme can be measured. However, the

1. Our comparison here is with the formal school. Where the purpose is to ascertain how an educational project affects practical knowledge, a number of variables intervene such as how a piece of knowledge is reinforced, the attitudes of parents and friends, etc.

equation makes clear that control variables are needed to account for environmental factors. These variables can be included only if an acceptable control group is available to the researcher.

Given the complexities inherent in the learning process, it is difficult to get a realistic estimate of the effects of an educational project without using the production function approach described above. Unfortunately, few studies in developing countries have succeeded in isolating the various controls called for in the model. Not only are such data expensive to obtain but the absence of historical records from the operating agencies make the V terms virtually impossible to estimate except through the recall of the programme participants themselves. While the use of a recall measure is better than the use of none at all, it is unlikely that the recall method is sufficiently reliable to capture major past influences. This is because the interviewer is left with the task of defining what these alternative educational exposures might have been and with the unenviable problem of rendering alternative educational exposures comparable. For these reasons the control group remains one of the most intractable difficulties in effectiveness analysis.

Three measures of outcome

Even in countries with highly developed educational systems, a confusion exists as to the level of effectiveness at which a project should be evaluated. At least three levels can be identified. In the case of the first level, effectiveness is defined in terms of the number of students reached, in the second in terms of the new skills acquired, and in the third by the extent to which behaviour is altered by the educational project. These are fundamentally different measures, whether one deals with the complexity of the measure, its composition, or its implications. Since all three have been utilized in the literature it is useful to consider them in some detail.

A target measure of outcome

The first measure is based on the concepts of target and actual audience developed elsewhere.[1] A project administrator selects or is assigned a target audience. After the project is implemented it reaches some fraction of that audience between 0 and 100 per cent. The closer it gets to the latter percentage the more intensively it is operating and the more efficient it may be considered in reaching its intended audience.

Using this criterion, it is possible to measure the effectiveness of the formal schools in terms of the difference between the actual number of

1. H. Tuckman and T. Nas, *Educational Technology in Developing Countries: The Allocation Issue*, Washington D.C., AID, 1978.

students the schools have in average daily attendance and the potential number. Likewise, in an instructional radio context, the comparable measure might be the difference between the number of potential students in the target population and the number of students actually reached. In either case, the difference is expressed as a percentage of the potential audience.

Such a measure is preferable to a measure based on actual audience participation since the latter favours projects with large numbers of participants, as in studies which use average cost measures.[1]

A target measure of effectiveness has several other advantages. It involves delineation of the regions, age groups, sex, and other characteristics of the target group. Once the appropriate groups are defined, data can be obtained from the Census Bureau, or by survey. In the process of developing the measure, the question of which elements an organization should serve will almost inevitably arise, especially if it turns out that the project is reaching a large number of non-targeted persons.

By this measure, the best project is the one which reaches the largest percentage of its target audience. A project which defines its population too broadly or which fails to capture the interest of its listeners is penalized. Of course, it is possible for a project administrator to make his project look more efficient by selecting a target audience which is easy to reach. However, there are limits to his ability to do this. The target measure also gives rise to an optimal decision rule. Given two projects, the one preferred is that which is able to reach a higher percentage of its potential audience per dollar of output than the other.[2]

As might be expected, a target measure of effectiveness is vulnerable to criticism precisely because of its simplicity. A definition of effectiveness based solely on presence is indeed a narrow one. In a classroom context, the presence of children in a learning context does not mean that the children are listening, or learning. In an instructional radio setting, the fact that a radio set is on does not mean that it has the attention of the people in the room. Presence is not synonymous with absorption and should not be treated as if it were.

A second criticism of the measure is that it takes the project's definition of the target audience as the desirable one. While it may be true that a particular project is targeted at the most suitable audience, the possibility also exists that it is not. Suppose, for example, that project A is designed to provide elementary training in literacy while B is focused on providing job skills. In a labour market where more persons are

1. In studies of these types, a country like the Republic of Korea will appear to have a highly efficient technology even if it uses a costly technology because of the large population to which the technology is applied.
2. Our assumption here is that efficiency is the sole criterion. As we shall argue later, equity considerations also enter into the decision process but it is best to allow this to be done through explicit trade-offs between equity and efficiency.

needed with job skills, B may have greater value than A if judged from the perspective of society. Use of the target measure alone without regard to other socially defined criteria might lead to the choice of A even though B yields larger social returns. In this instance, the target measure yields an inefficient choice because it ignores the value of what is being taught.

On the other hand, many project studies are conducted *ex post facto* and are intended primarily to provide an indication of how effectively these have reached their intended audience. In this context, the above criticism is irrelevant and the target measure is useful in providing an idea of the 'slack' of a project; that is, of the distance that a project has to go to obtain optimal coverage. This measure can be useful in helping programme administrators to see where they can increase the intensity of participation in their programme.

Achievement measures

A second set of measures of effectiveness involves the use of one or more achievement test to determine student performance. Usually obtained by using both an experimental and a control procedure, this method provides information on whether the participants in an educational project are learning more than those who do not participate. This approach is frequently employed in cost-effectiveness evaluations of the formal schools and has found its way into several instructional radio studies.[1] At this level, the focus is on the development of a set of skills, not on the use of these skills in daily living.

In the developing-country context, a variety of testing procedures have been utilized, sometimes within a single programme. For example, in the Radio Mathematics Project conducted in Nicaragua, Searle and her colleagues used three means of evaluating achievement.[2] In the first phase of their project, worksheets were used to determine both the rate at which it was possible to reduce the number of detailed instructions and the extent to which the students were learning the material. In the last part of the school year, the project used a testing procedure to provide information about competency before, during, and after instruction in many topics. And to evaluate overall performance, a pre- and post-test was given to both programme participants and to a control group of nine classes that did not listen to the radio programmes.

In contrast, White[3] used median examination scores on six subject examinations—language, grammar, mathematics, natural sciences,

1. See, for example, E. M. Rogers, J. R. Braun and M. A. Vermilion, 'Radio Forums: A Strategy for Rural Development', in Spain *et al.*, op. cit., Chapter 11.
2. B. Searle, P. Suppes and J. Friend, 'The Nicaraguan Radio Mathematics Project', in Spain *et al.*, op. cit., p. 28.
3. R. A. White, *An Alternative Pattern of Basic Education: Radio Santa Maria*, Paris, Unesco, 1976. (Experiments and Innovations in Education, 30.)

Dominican economy and social studies—to compare the performance of grade-6 students in schools using radiophonic and conventional classroom methods in the Dominican Republic. The wide range of possible achievement measures, and their similarity to the testing methods that we are accustomed to, make these measures popular among researchers.

The education profession itself has questioned whether performance tests are the best measures of educational output. The criticism of achievement-based measures of outputs usually involves one or more of the following arguments; the measures are slanted toward the value structure of the person constructing the test, the measures do not adequately reflect the weights given to the material by the instructor, the measures do not measure the student's ability to analyse or retain but rather to memorize, the tests are culturally imbedded, the tests are administered in too short a period of time.[1] While most of these criticisms apply in the developing society context, they pale beside the problems involved in collecting reliable achievement data on a large-scale programme such as *Movimento de Educação Basica* in Brazil or the Popular Promotion Movement in Honduras.

Achievement test measures are also criticized because the conclusions reached about the effectiveness of a project or set of projects are not invariant to the testing procedure used. A test with a large number of questions is likely to show a larger point score increase than a test which consists of few questions. Likewise, a test with 'easy' questions will yield both a different mean and a different distribution of responses than one which is 'hard'. While these objections are not damaging if the same test is used to evaluate alternative projects, they are very telling for cross-country comparisons of radio school projects. In the latter instance, serious comparisons are impossible if different test procedures are used.

A related argument involves the question of how to weight performance on the different achievement tests.

A set of output weights can sometimes be obtained from project planners or administrators. But the weights developed from these sources may differ from those of the society as a whole. Moreover, unless all of the tests use similar questions and tests for the same forms of learning, it is questionable whether they can be added together to provide an aggregate measure of effectiveness. It can be argued that while a project has several outputs, the effectiveness measures and cost of each output should be presented separately and no aggregation should be attempted. None the less, some researchers are likely to be unable to resist the temptation to evaluate an educational project using a single aggregate index.

1. An interesting discussion of several of these issues appears in E. M. Gramlich and P. R. Koshel, *Educational Performance Contracting*, Washington, D.C., Brookings Institute, 1975. Note especially Chapters 4 and 6. The elements of construction appear in N. E. Gronlund, *Constructing Achievement Tests*, Englewood Cliffs, N.J., Prentice-Hall, 1968.

Finally, because no uniform and widely available set of achievement tests is available to researchers, it is likely that educational projects will continue to be evaluated in terms of different achievement measures. This will make it difficult, if not impossible, to compare the effectiveness of individual projects. Achievement measures are likely to continue to be most effective where they are utilized in a context where the same measures can be used to evaluate several projects.

Behavioural measures

Measures of the behavioural changes brought about as a result of an educational project are designed to capture those elements of learning which get translated into concrete action. These are probably best suited for evaluating the effects of multiple output projects and of projects involving changes in 'the nature of man'. More subjective than achievement measures, behavioural measures are a step removed from the learning process; they are also more likely to be sensitive to the effects of external variables. That the two measures are not the same has been documented by Levin, and the low correlation between achievement in school and career progression has been demonstrated by Jencks.[1] To the extent that effectiveness is measured in terms of the behavioural outcomes of a project rather than through achievement scores, the results obtained using the former measures are likely to diverge from those obtained using the latter.

Which of the two measures is preferable depends on whether the goal of a project is to raise achievement levels or to change behaviour. A knowledge that a particular educational project raised reading scores 10 per cent while another raised them 5 per cent does not necessarily mean that the former was more effective than the latter if the purpose of the projects was to enable the programme participants to utilize their skills to read the newspaper. Similarly, a programme designed to teach people how to utilize money may be a success in teaching mathematics skills but a failure in getting people to use these skills.

In some developing countries, particularly those of Latin America, the educational media are not used primarily to transmit educational skills for their own sake but rather to encourage desired types of behaviour. White puts the case well in discussing the orientation of radio schools in Colombia, Brazil, Chile and Honduras:

> Although these models or the programs influenced by them vary in their emphasis, generally they have attempted to integrate adult basic education through radio schools with a system of leadership training and community organization which is intended to serve, at least indirectly, as the basis for rural

1. H. Levin, 'A Decade of Policy Developments in Improving Education and Training for Low Income Populations', in R. Haveman (ed.), *A Decade of Anti-Poverty Policy: Achievement, Failures, and Lessons*, Chapter 4, New York, Academic Press, 1977.

interest-group formation. The learning of specific skills such as literacy is seen not as an objective in itself, but as the medium through which there is created an awareness of community problems or social and political injustices that are assumed to be the real factors in underdevelopment. The general objective is also frequently described as *desarrollo integral*, integral development which takes into consideration all major dimensions of human personality.[1]

Effectiveness is measured in this context by a different set of criteria from those used to capture achievement. Mastery of any single skill is not sufficient to accomplish the goals of integrated education. Instead, success is achieved when the participants in an educational project develop a level of awareness which, in turn, is translated into a concrete set of actions. Presumably, such awareness may be created through several different types of instruction. However, the common characteristic of all of these is that they are directed toward augmenting their participants' abilities to cope with real world situations. The choice of measures to determine the effectiveness of this type of education thus rests on a prior concept of what behaviours the 'aware' participant should engage in.

In contrast to the achievement measures, those which are based on behaviour capture what the participant does, not what he or she thinks. Behaviour may be easier to measure than learning since what people do is often observable while what they learn sometimes is not. If a programme is designed to promote community organization, its success can be judged by how many persons have joined a community organization; if its goal is to encourage its participants to save, the success of the programme can be judged on whether the savings rate increased.

The behavioural measure involves a more complex set of behavioural responses than the achievement measure and as a result it lays down a more stringent measure of effectiveness. For behaviour to change, the following conditions must exist; the person must participate in the project, he must understand and absorb the message the project is trying to convey, he must agree that some of the proscribed behaviours are 'good' or that they are at least worth trying, and he must actually try them. Particularly in the case of the latter two steps, strong internal constraints may exist which a project must overcome. Thus, it is not surprising that some earlier studies have found organizations less effective when a behavioural rather than an achievement measure is used.[2]

Virtually no limits exist to the types of questions that can be asked to uncover changes in behaviour, especially in projects which deal with the development of a 'new' man. Measures can be formulated to determine the participant's ability to use a tooth-brush, knowledge of the

1. R. A. White, in Spain *et al.*, op. cit.
2. Compare, for example, S. F. Brumberg, 'Colombia—A Multi-Media Rural Education Programme', in *Education for Rural Development—Case Study for Planners*, New York, Praeger Publishers, 1975, with S. Musto, *Los Medios de Communicación Social al Servicio del Desarrollo Rural*, Bogotá, Editorial Andes, 1971.

health-giving qualities of milk, ability to care for an animal, skills in trade, etc. A project evaluator is faced with a large number of judgements regarding how many questions to use to validate changes in each type of behaviour, the weights to give to each type of behaviour, and whether to measure for the *intensity of an action* or solely for the existence of an action. The final set of questions provides an indication of the researcher's (or the organization's) view of what behaviours a properly educated person should exhibit.

Presumably, those types of behavioural change are desirable which move the project participant in a direction that a moral and well-intentioned educated person would follow. None the less, not all behavioural changes are alike either in intensity or in consequence. A participant may learn to boil water or to brush his teeth. These are desirable activities because they have an impact on both health and life-style. Both involve a one-time level of awareness, however. Once the lesson is absorbed, presumably no further education is needed on how to accomplish the task; repetition may be useful to reinforce the newly acquired behaviour but not to convey new knowledge.

In contrast, teaching a participant to engage in community-organizing activities may require several years. Both the magnitude of the teaching task and the benefits of this type of learning differ substantially from the behaviours described above. An effectiveness measure designed to capture this type of behaviour can take many different forms. It may focus on the one-time question of whether the person ever engaged in this type of activity or on the intensity of the person's activity. In either case there is substantial room for discretionary differences among researchers. It is highly unlikely, for example, that two researchers evaluating instructional media in two different countries will use the same tools. As a result, cross-country comparisons of educational projects using behavioural measures are likely to involve behavioural measures which are not easily compared.

Given the objectives of many educational projects, behavioural measures are likely to continue to be favoured in many effectiveness studies. Since they provide a quantitative measure of change, and since they span a broad range of outputs, these measures are well suited for use in effectiveness-cost analysis. However, substantial development work needs to be undertaken to arrive at a set of effectiveness measures which can be used in cross-country comparisons.

Aggregate economic measures

In addition to the three measures discussed above, it is sometimes useful to examine the effects of a project on several aggregate measures of economic activity. Analyses of this type are less useful for evaluating the effec-

tiveness of a project in its own terms than for capturing the overall effect that the project has on economic development. They are also often used to explore how the project contributes to the upgrading of the lower income groups in a society.

Four types of measures are usually used to evaluate economic impact. These deal with the productivity, mobility, accumulation, and income distribution effects of a project. While the literature in the field of economic development is fairly extensive, studies on the use of these four measures for evaluation of educational projects are only now beginning to appear.

Several different types of productivity measures have been used to measure the effectiveness of educational projects. The most frequently found set of studies of this type examines the impact of formal education on earnings.[1] An earnings measure is frequently favoured by educational economists because it utilizes data that are comparatively easy to acquire, requires relatively little analytic sophistication to construct, and usually produces fairly sophisticated results which can be used to compare the rate of return on education to the return on other forms of investment. Thus far, this approach has not been well developed for non-formal educations because of the low level of earnings of the population served and the difficulties inherent in translating non-monetary incomes into a monetary equivalent. It is also difficult to forecast future earnings, a necessary step for rate-of-return analysis, because of the uncertainties inherent in subsistence farming.[2]

An alternative productivity measure favoured by Griliches and several other economists involves the use of an education measure in a production function for agriculture to estimate the contribution that education makes to agricultural output.[3] A production function relates the inputs used in a particular industry to the outputs. So far, comparatively little has been done to study the role of instructional radio or of other non-formal methods of augmenting agricultural productivity. Through time, more of these efforts are virtually certain to come.[4]

1. M. Carnoy, 'Rates of Return to Schooling in Latin America', *Journal of Human Resources*, Summer, 1967, p. 359–74; and C. Jencks *et al.*, *Inequality*, New York, Basic Books, 1972.
2. While rural earnings may also be generated from the sale of crafts, from the production of bread or other items, or from trade, for the majority of the population in rural areas they are agricultural. As such they depend on geography, the insect population, and a host of other events determined by nature.
3. Z. Griliches, 'Notes on the Role of Education in Production Functions and Growth Accounting', in W. L. Hansen (ed.), *Education, Income, and Human Capital*, New York, Columbia University Press, 1970.
4. M. E. Lockheed, D. T. Jamison and L. J. Lau, 'Farmer Education and Farmer Efficiency: A Review of the Literature', unprocessed paper, Washington, D.C., 1978. See also M. R. Rosenzweig, 'Farm-Family: Schooling Decisions: Determinants of the Quantity and Quality of Education in Agricultural Populations', *Journal of Human Resources*, Winter, 1977, p. 71–91.

Education can have a significant effect on the distribution of the population between rural and urban areas. In a study of Radioprimaria in Mexico, Spain found that:

A consistent desire for education came out, but with it came the conviction that education is a vehicle by which to escape the rural area. The rural people do not feel that their area was 'developable', only that some children could develop themselves enough to go elsewhere. Elsewhere means the city of San Luis Potosí. The rural people believe that better job opportunities await them there if they come with their primary certificate in hand. Yet that many jobs do not exist.[1]

As this quote illustrates, in a country with limited positions for the semi-educated, the impact of education may be to create unemployment and dependence if it causes migration to the cities. The administrators of many instructional projects have recognized this problem and some try to encourage their participants to remain in rural areas. The issues surrounding the question of whether urban migration is a positive or negative force for change are complex and depend to a large extent on the nature of the country. It is sufficient to note here that because of the importance of this variable some studies have treated it explicitly in evaluating project effectiveness.

Measures of accumulation constitute the third broad class of economic aggregate measures. Perhaps the most important of these involves the rate of capital formation. Capital formation is a much more significant determinant of growth in a developing country than in a developed one because of the existence of under-utilized labour. As the amount of capital available for production increases, the output level of the society and the number of jobs it can sustain may increase as well. To the extent that education increases savings, through improvements in existing farming techniques, reducing the costs of trade, encouraging persons to save, or other methods, and to the extent that these savings find their way to the productive sectors, growth in aggregate output can be achieved.

Accumulation may also be important in a less visible sense. The wealth level of a country cannot be ascertained simply by looking at the amount of goods and services it produces each year. Particularly in developing countries, many items simply do not enter into the measured accounts.[2] For example, in rural areas, educational participants are often encouraged to build new homes, to add on to existing ones, to construct animal shelters, and to engage in other activities which increase their wealth. Measures of accumulation that capture the increase in wealth resulting from participation in an educational process provide a valuable source of data on economic impact.

1. Spain, op. cit., p. 69.
2. Wealth data are difficult to obtain in developed countries as well. What makes the problem especially intractable in the developing countries is the need to value products not traded on the market.

Income distribution measures represent the last category of aggregate economic indicators. Economists are careful to distinguish those effects which involve the efficiency of a project from those of an equity nature.[1] Distributional effects involve equity considerations and, in this sense, they represent the most subjective of all of the effectiveness indicators considered in this paper. They address at least three major questions: Which income groups pay for a project and which are the recipients? To what extent does participation in a project change a person's position in the income distribution relative to his position if he had not participated? To what extent does a project change the distribution of income at the regional or community level?

Income distribution effects should not be combined directly with measures of effectiveness.[2] An efficient project is one which raises a society's total output. How that output should be distributed involves a set of judgements which are unrelated to the efficiency of the project. This does not mean that equity effects should not be considered in choosing among alternative projects. On the contrary, it is exceedingly useful to present decision-makers with a set of cost-effectiveness ratios and a set of likely income distribution measures for the projects under consideration. In the final selection process decisions can then be made regarding the trade-off between effectiveness and distributional effects.

Comparisons among projects conducted in different countries are particularly difficult to make when distributional issues are involved. This is because it is difficult to compare changes in two distributions when these distributions differ. Is it 'better', for example, to have 2 per cent of the population move from an income of US$200 to $300 in a country where 10 per cent of the population have incomes in excess of $10,000 than to have 2 per cent of the population move from $200 to $400 where 20 per cent have more than $10,000? A number of variables are likely to influence a judgement involving the income distribution consequences of alternative projects. In some instances these may be inconsequential, as in the case where comparisons of the mode of financing educational projects have been made cross-country.[3] In others, it is virtually impossible to make meaningful statements, as in cases where large regional differences emerge in the effectiveness of a project.

Income distribution indicators are important and they belong in

1. For an excellent discussion of this, see A. M. Okun, *Equality and Efficiency: The Big Tradeoff*, Washington D.C., Brookings Institution, 1975.
2. This argument closely parallels the one used in benefit-cost analyses. It is not valid to try to capture equity and efficiency impacts in the same measure since the former net to zero in the aggregate while the latter have a positive or negative effect on domestic output.
3. See J. P. Jallade, *Public Expenditures on Education and Income Distribution in Colombia*, Baltimore, Md., Johns Hopkins Press, 1974 (World Bank Occasional Paper, No. 18).

studies of the effectiveness of educational projects. They should be used cautiously, however, and with care in interpretation; they should not be directly incorporated into an aggregate measure of effectiveness.

Is there a best measure?

It should now be clear that no single effectiveness measure captures the various ways in which the effectiveness of an educational project can be evaluated. A measure which compares actual participants with target participants serves a useful purpose in indicating the extent to which a project is reaching its target group. It also provides an external check of whether a programme is working close to capacity or whether it is reaching only a limited portion of its potential audience. Likewise, a measure based on achievement scores provides quantitative data on the extent to which a project succeeds in conveying a set of skills. Even if the goal of that project is to provide an integrated education, it may be useful for comparative purpose to be aware of how effectively it delivers the skills that its participants are expected to integrate.

Similarly, it is helpful to know how a programme alters behaviour even if it defines its goals purely in learning terms. A programme designed solely to augment literacy or mathematics skills may none the less create unintended by-products. Its participants may use their new-found skills to read about the care and feeding of animals, to obtain news about friends from a local newspaper, and/or to engage in religious studies. A change in behaviour which results from an educational project, whether positive or negative, is a valid output of the project and a well-constructed measure should take this change into account.

While there are good reasons for espousing the use of multiple-effectiveness measures in educational project evaluation, the use of a multiple measure can compound the process of project selection. Suppose, for example, that a decision-maker must select among three alternative projects and that an appropriate effectiveness measure exists for each of the three cases describes above. For the sake of simplicity, assume that each project costs $100 and that the effectiveness/cost ratios are as shown in Table 1.

TABLE 1. Project selection given three alternative effectiveness measures

	Effectiveness/cost ratio		
	Project A	Project B	Project C
Target audience	0.8	0.6	0.3
Achievement score	30.0	70.0	20.0
Behavioural measure	20.0	30.0	45.0

What Table 1 illustrates is that the ranking given to a particular project may depend upon which effectiveness measure is chosen. As shown, each measure is based on a different scale; thus, the separate measures are not easily aggregated.[1] One cannot argue, for example, that since the achievement score index has the largest value it should be given the greatest weight. Likewise, it cannot be argued that since project B has the greatest point spread difference in achievement scores it is the most desirable one. In this instance, the decision must be made on the basis of which measure most accurately reflects the goals the project is designed to fulfil.

Having examined several of the problems associated with constructing effectiveness measures, we turn now to the issues involved in acquiring the data needed for constructing these measures. While many of these problems are probably familiar to practitioners in the area, this type of exercise is useful in highlighting the uncertainties associated with effectiveness measures.

Alternative ways of collecting data

Several methods are available for gathering information to construct effectiveness measures. These are considered in this section. The question of which is the best method depends on the nature of the effectiveness problem and the environment in which the educational project operates.

Data gathering by survey

This procedure involves gathering data directly from the population the programme is intended to reach. Usually questions are asked involving a set of control variables and a set of quantitative measures of outcomes. These may include achievement scores, questions concerning the person's opinion of the effects of the educational project, etc.[2]

The level of detail or specificity of the questions is determined either in isolation or preferably as a result of case-studies conducted in selected regions. In either case, supportive information with respect to the socio-economic characteristics of the various regions should also be obtained.

Though this technique is extremely useful in obtaining information directly from programme participants, it has several limitations. First, there is the problem of sampling. Since there are usually no data available

1. It is possible, of course, to utilize a scale which renders the three measures equivalent or to design a single measure which contains indicators for each of these levels of effectiveness. This does not avoid the weighting problems discussed earlier, however.
2. We are extremely sceptical of measures of the latter type since the respondent may provide the answer he or she believes the interviewer wishes to hear.

on the actual population of a large educational project, it is difficult to draw reliable generalizations based on data drawn from a sample. While the data may be highly reliable, it is not certain that they are representative of the target population. Usually no simple way exists to validate them.

Second, due to regional differences, a single instrument which is utilized in a whole country may produce an ineffective and unreliable set of data. It is possible to avoid this problem by designing region-specific questionnaires. However, this is likely to be a costly and time-consuming procedure and it makes the final measures difficult to aggregate. A preferable procedure is to use a pre-test of the instrument to identify questions that are applicable to all of the regions. While this narrows the scope of the inquiry somewhat, it greatly reduces the task of making aggregate statements about a programme. The risk in this procedure is that it may introduce a bias into the analysis by excluding major problem areas or by providing data which are less reliable for some regions than from others.

A third problem relates to the accuracy of the participants' response. The high illiteracy rate in the rural areas makes it difficult for participants to respond accurately to written questions, particularly those which involve fixed responses. Of equal importance is the difficulty in obtaining reliable information related to the participants' property and welfare. Some respondents will be reluctant to divulge information of this type to outsiders, some will not understand the question, and some will simply not know the answers. If the analysts are trained in how to ask questions, this problem will be lessened but it will not disappear. It is also essential for the interviewers who administer the instrument to spend time with the interviewees so that their observations and the participants' more trustful feelings will reduce the danger of incorrect responses.

Data from programme administrators

When field surveys are not feasible because of time, budget, or political constraints, it is often possible to obtain information from a programme's field staff. These staff are often a useful source of data both on how a project actually operates and on whether it is teaching its target population. However, the possibility exists that the information provided by the staff is biased in favour of the organization's stated objectives. In this case, the data may not reveal what the organization actually does.

Second, the programme staff may not be willing to reveal information on the negatives of the programme. This will be especially true if divulging such information will affect their own position in the organization. For these reasons, data of this type are not normally used in constructing an effectiveness/cost ratio. If no other data can be obtained, it may be preferable to report these data as illustrative but to avoid a direct comparison of effectiveness and cost.

Data from national and international agencies

Aggregate indicators of literacy, health, income and income distribution, etc., compiled by national or international agencies, can sometimes be used in effectiveness analyses at the aggregate level. This is particularly the case where projects have large national audiences and where their goal is to alter specific social indicators, i.e. to reduce illiteracy. There are several difficulties, however. The primary one is that it is hard to untangle the effects of one organization from those of another. Rarely, if ever, are indicators available which cover the activities of only one educational project. Second, the information obtained from these reports may not be comprehensive or complete enough to be useful in an effectiveness study. Unless suitable controls are introduced, cross-country comparisons are likely to be too crude to yield meaningful data on the value of alternative educational projects.

Use of other countries' experience

Effectiveness studies of the educational projects operating in other countries provide operating experience and some insight into the problem associated with introducing a new educational technology. But they should not be the sole basis for deciding what type of project to adopt.

The goals of a project are likely to change as it is shifted from one country to another. For example, an instructional radio project may aim to reach the adult population of one country whereas it may be suited to supplement the public schools in another. Thus, the effectiveness criteria on which each project would be judged would differ. Even if the educational projects of two countries are similar in terms of structure and goals, they may still produce different effects because of environmental differences. It is essential that a country relying on the experiences of other countries in selecting among educational projects pay careful attention to the question of how its own social and economic characteristics might affect these projects.

Conclusions

The discussion in this chapter suggests the substantial difficulties inherent in acquiring a suitable effectiveness measure. Problems exist in defining the level at which effectiveness should be measured, in defining the elements that enter into such a measure, and in obtaining data that will be both reliable and valid for measurement purposes. Serious problems also exist in attempting to aggregate the various outcomes to define an overall picture of effectiveness. These problems are somewhat lessened when the sole purpose of the analysis is to determine whether an edu-

cational project makes a difference; that is, whether the participants in a project have a higher level of proficiency in a given area than the non-participants. The problems are most acute when there is a need to develop a cost/effectiveness ratio by which the alternative projects can be judged.

For these reasons it is hardly surprising that the vast majority of effectiveness studies pay homage to the concept of cost-effectiveness analysis but fail to practise it in reality.[1] Most such studies provide a limited number of measures usually based on achievement and most ignore both the aggregation problem and the issue of the level at which the analysis is to be conducted. While we offer no simple alternative to these approaches, we do believe that a careful study of effectiveness should include measures directed at the several levels discussed in this chapter. By providing data of these types, the researcher allows those persons concerned with project selection to utilize their own criteria for selection.

The use of health statistics as an effectiveness measure in certain development communications projects

Joanne Leslie

Introduction

The possibility of using communications technology to promote various development goals is receiving increasing attention from planners and researchers. This paper focuses on the use of communications technology, particularly the mass media, to improve the health and nutrition status of a community through non-formal health education. It is suggested that the effectiveness of such projects should be measured in terms of health outcomes as well as education outcomes, because it cannot be assumed that improvements in health knowledge, attitudes or behaviour will necessarily bring about improved health. In this first section, a brief review of the use of mass media for health and nutrition education in developing countries is presented. In the second section, a paradigm for evaluating the effectiveness of mass-media health and nutrition education

1. For a critique of these studies, see: M. Carnoy and H. Levin, 'Evaluation of Education Media: Some Issues', *Instructional Science*, 1975, Vol. 23, No. 2, p. 207–48.

projects is developed. In the third section, three health sector development communications projects that have included health outcomes as one measure of effectiveness are described. In the final section, the advantages and disadvantages of using health statistics to measure effectiveness of mass-media health and nutrition education projects are summarized.

The assumptions underlying the use of mass media for health education have typically included the following:

Mass media can reach large numbers of people in a short period of time; the use of mass media is particularly valuable for reaching people in sparsely populated or relatively inaccessible regions.

Where competent professionals are scarce or concentrated in the urban centres, the mass media may provide the only way that professional advice can be distributed throughout the country.

Costs per person reached can be quite low, particularly in the case of radio or newspapers where the media are usually already in place.

An additional assumption underlies the use of the strategy of non-formal education to improve health and nutrition; this assumption is that poor health in the community is due to a lack of knowledge or a poor attitude as well as to a lack of resources.

There are also certain common assumptions made concerning the disadvantages of using mass media for non-formal education; the most frequently cited are the following:

The educational message cannot be individualized so the mass media are limited to issues for which the same advice is appropriate for many people.

The mass media usually have lower credibility than interpersonal communication.

The possibilities for interaction or feedback are limited.

Considerable experience has already been accumulated (from both research and non-research projects) with the use of mass media for health sector development. Mass-media non-formal education projects in health and nutrition have been diverse and imaginative; the following are just a few of the more interesting examples:

A one-year campaign in the mid-1960s by the Mexican Consejo Nacional de la Publicidad to prevent accidents [1].[1]

A poster campaign, which began in Zaire in 1962 to teach nutrition and prevention of malaria, intestinal parasites and tuberculosis, and which now distributes health material to fifteen African countries [2].

A six-week campaign in 1974 by the Housewives' Association of Trinidad and Tobago using radio, television and newspapers to promote breast-feeding [3].

A series of television programmes, called the *Senior Chef*, which were produced in Canada in 1972 to teach nutritious and economical food preparation to the elderly [4].

1. The figures in brackets refer to the references at the end of this article.

Although there have been many projects in which the mass media have been used for non-formal education in health and nutrition, they provide only limited guidance as to whether such interventions should be undertaken in the future or under what conditions they can be expected to be successful, because few of these projects have been carefully evaluated. In addition to the usual financial, administrative and political deterrents to evaluation, we lack a well-developed methodology for evaluating health education projects [5, 6, 7, 8].

In an earlier paper, this author reviewed fifteen mass-media health and nutrition education projects in low-income countries for which some quantitative measures of effectiveness were available [9]; this review led to five conclusions.

The evaluations clearly confirm that mass-media health and nutrition education projects can reach large numbers of people (up to several million) in a relatively short time. Although there is a considerable range in costs among the projects, the evaluations also show that it is possible to achieve this outreach at a cost as low as $0.01 per person.

As far as achievement of educational objectives is concerned, the evaluations suggest one positive conclusion: between 10 and 50 per cent of those reached by a mass-media health or nutrition education project will remember the main message of the programme, at least during or immediately after the project.

There is some indication that people will adopt new health or diet related behaviours due to mass-media health or nutrition education projects; however, these reported effects must be interpreted cautiously because most are self-reported behaviour changes, and many other factors were simultaneously affecting the target audience.

There is no evidence concerning the long-term retention of knowledge gained from mass-media health and nutrition education projects, and there is almost no evidence concerning the impact of such projects on the short-term or long-term health status of the target audience.

Although systematic information on this final conclusion is currently unavailable, mass-media education projects in the health and nutrition fields seem less likely to be successful as a substitute for personal contact and the direct provision of services than as an extension of the outreach of such interventions or as a reinforcement of their messages.

The above conclusions are an incomplete guide to decisions concerning the inclusion of mass media-based non-formal education in health sector development. By expanding the range of effectiveness measures used to evaluate education projects in health and nutrition, it should be possible to learn more from future evaluations.

Evaluation methodology

Discussion in this paper is limited to just one component of evaluation, measurement of effectiveness, and to just one area of development communication, non-formal health and nutrition education using mass media. The reader interested in pursuing evaluation methodology further is referred to several reviews illustrating the wide range of possible approaches to evaluation [10, 11, 12, 13]. The particular problems that arise in evaluation of mass communications projects are well illustrated in three recent surveys of mass media projects [14, 15, 16] and are analysed in detail by Lumsdaine [17].

Figure 1 presents three categories of effectiveness measures for the evaluation of mass media health and nutrition education projects. Outreach is the most easily measured effect of any mass media project. Outreach measures may include the number of messages produced, the extent of media distribution and/or the actual number of people reached. Records at the project headquarters will usually suffice to establish both how many messages were produced and the extent of media distribution. In the case of print-based projects, the extent of media distribution might

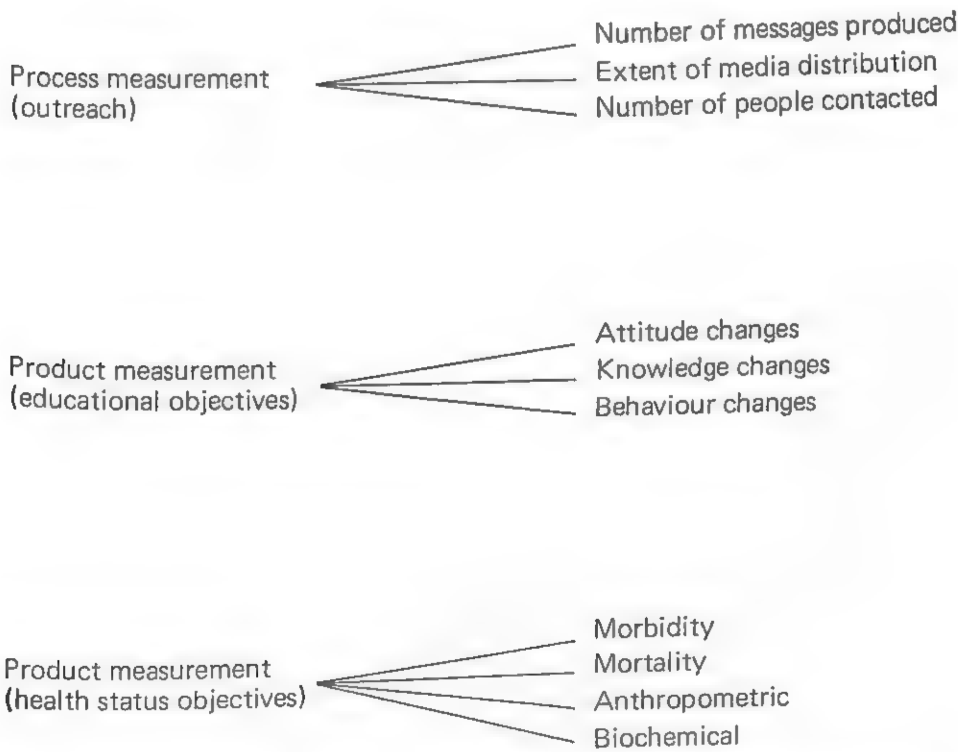

FIG. 1. Three categories of effectiveness measures for the evaluation of mass-media health and nutrition education projects.

be measured by the number of newspapers containing the message or the number of pamphlets or posters distributed. In the case of broadcast media projects, extent of media distribution might be measured by the number of stations broadcasting the message and the frequency and time of day of these broadcasts.

An estimate of the number of people reached by a mass-media project can be made from the number of subscribers to the newspapers in which messages were printed, or the number of working radio or television receivers in the reception areas of the broadcasting stations. However, more accurate numbers can be obtained by conducting an awareness survey in which an appropriately chosen random sample of the target audience is interviewed to determine the percentage having seen or heard the message.

The evaluations of many mass-media health or nutrition education projects have been limited to measurement of outreach. In some cases this was because the objective of the project was to distribute information, but more often it was because of the limited resources available for evaluation.

Where the evaluation has included more than a measure of outreach, most non-formal education projects in health and nutrition have been evaluated in terms of educational objectives rather than in terms of health objectives. This is at least in part because the effects on educational objectives are expected to occur more quickly, and to be more directly attributable to the project. The three categories of educational objectives that are usually measured are changes in attitude, changes in knowledge and changes in behaviour. Of these three, changes in knowledge are the most frequently measured. Eleven of the fifteen evaluations of mass-media health and nutrition education projects from low-income countries reviewed in an earlier paper [9] included a measure of knowledge change. Questions to determine changes in attitude are often included along with questions to determine changes in knowledge. The answers to attitude questions may be less reliable than answers to knowledge questions due to a desire to please the interviewer, but often a change in attitude will be more important than a change in knowledge in promoting changes in behaviour.

Changes in behaviour can be measured either by self-reported behaviour, or by actual measurements of behaviour. Self-reported behaviour is more frequently measured because questions concerning behaviour can be included in the same interview in which questions about attitude and knowledge are asked. However, if the respondents know what the desired answer is and they wish to please the interviewer, questions concerning behaviour are subject to the same bias as questions concerning attitude.

There are additional problems in assessing effectiveness using reported behaviour data. These can be illustrated by one technique that is commonly used in nutrition research, the dietary recall. There are several variations of this technique, but usually an interviewer asks one member of the

household (most often the mother) to list the types and quantities of food consumed by the whole family, or one person in the family, during the previous twenty-four hours. Such dietary surveys can sometimes be useful in describing the general food consumption patterns of a community, but they are unreliable for establishing the adequacy of an individual diet both because there is considerable variation in daily nutrient intake for most individuals and because important sources of nutrients consumed between meals or away from home may go unreported [18]. Often nutrient intake calculated from dietary surveys has been found to be incongruent with nutritional status as measured by anthropometric or biochemical tests, and with established minimal requirements [19, 20].

In measuring the effectiveness of a non-formal health or nutrition education project, there are many possibilities for establishing actual changes in behaviour, depending on the particular objectives of the project. If the objective is to promote digging wells or building latrines to improve sanitary conditions, then the actual number of wells or latrines built during and after the project can be counted. Number of wells dug was one measure of effectiveness in the evaluation of the television programmes on 'Water', broadcast by the Out-of-School Education Project in the Ivory Coast [21]. The Tanzanian radio campaign, 'Man is Health', was evaluated in terms of the number of latrines built, along with several other measures of effectiveness [22]. If the objective is to promote the use of other health services, then appropriate effectiveness measures may be the number of children vaccinated or the number of visits to a health clinic before and after the project. Another possibility for measuring actual changes in behaviour is to monitor the sales of particular foods; a radio nutrition education project in Ecuador used shipments of iodized salt into the mountain regions as part of its evaluation [23].

In the remainder of this section, a more detailed discussion of the third category of effectiveness measures presented in Figure 1, measurement of changes in health status, will be provided. There are a variety of techniques that might be adapted from evaluation of other public health interventions to evaluation of health or nutrition education interventions. In general, the health status of a community is assessed by measuring one or more of the following: mortality (sex and age specific death rates); morbidity (sex and age specific rates for different diseases); anthropometry (sex and age specific measurements of size or growth; height and weight are the most common measurement); biochemical tests (chemical analysis of organic specimens, most commonly blood, urine or fecal matter).

It is possible to use all of these measures, except mortality, to assess the health status of individuals as well. Measurements of the above may be obtained either from special surveys done to evaluate a particular project or from routinely collected data. The most common sources of relevant, routinely collected data would be national vital statistics sys-

tems, hospital or health clinic records, and nutrition or disease surveillance systems. However, most often these routinely collected data are aggregated at the national or regional level and, therefore, could only be utilized to evaluate a project that reached an entire country or region.

In a recent study by the World Health Organization [24], it is suggested that the three most useful indicators of the general health and nutrition of a population that can be derived from routinely collected data are: proportion of all deaths occurring under age 5; proportion of low-birth-weight new-borns; average height at school entrance.

However, precisely because these are indicators of general health and nutrition status, they are influenced by many factors simultaneously, and may be inappropriate for most evaluations.

When a non-formal health or nutrition education project is focused on one or more specific health problems, such as (a) boiling water to reduce diarrhoea among pre-school children, (b) improving the quality of weaning foods, or (c) reducing deaths from neo-natal tetanus, it would be most appropriate to use a closely linked health statistic for measuring the effectiveness of the education project. Examples of appropriate statistics for the three health objectives listed above would be (a) the rate of diarrhoea among 3-year-old children, (b) the weight for height of 2-year-old children, and (c) neo-natal mortality.

Surveys to establish the prevalence of a particular health problem in a community, such as those listed above, can be done by interviewing health workers, interviewing a sample of the households or examining a sample of the target group. Depending on the specific problem being assessed, such an examination might involve recording clinical signs of disease, taking anthropometric measurements, or obtaining samples for biochemical tests. The examination method is often more reliable than the interview method, but usually necessitates special equipment and training of field workers. The reader interested in conducting such a survey is referred to a publication by the World Health Organization, which provides a detailed description of suitable methods for measuring the prevalence of health problems in a community, with particular reference to the situation in low-income countries [25].

Most changes in health status statistics occur relatively slowly, at least with reference to the health status of a community rather than the health status of individuals, and therefore would be more appropriate for measuring the effectiveness of a long-term education project. However, occasionally, a short-term education project might be aimed at causing a fairly rapid change in health status at a particularly vulnerable time. One example would be an education project aimed at increasing the calories consumed by women during the third trimester of pregnancy in a community with a high rate of low birth-weight infants. In this case, it would be possible to use the appropriate health statistic, percentage of infants born below a certain weight, to measure effectiveness after just a

few months of the project (assuming an adequate sample size for the evaluation).

Before going on to look at some examples of health-sector development communications projects that have used health statistics as a measure of effectiveness, it is worth considering briefly what evidence there is that health or nutrition education should have an effect on health status. It is clear that the motivation underlying most non-formal education in health and nutrition is to do more than increase knowledge or to change attitudes; there is an assumption that the ultimate effect will be to contribute to an improvement in health [26].

Research concerning the effects of nutrition and/or health knowledge on health status is limited, but available studies from low-income communities suggest that greater knowledge is not always correlated with better health. Wagstaff measured nutrition knowledge of different groups of South African blacks and found that mothers of children below the third percentile of weight scored similarly to mothers of better nourished children on a test of nutrition knowledge [27]. In Kinshasa, Zaire, no relationship was found between a mother's having taken a nutrition education course and the health status of her pre-school child [28]. A study in Lebanon found a positive correlation between nutrition knowledge of mothers and the height for age of their children, but the mothers who scored better on the test of nutrition knowledge also had more years of schooling and a higher family income [29]. Another study of the effects of nutrition knowledge was done in connection with a nutrition education programme for pregnant women of Mexican descent in the United States [30]. This study found that improved nutrition knowledge was positively correlated with increased intake of protein and some vitamins during pregnancy, but no relationship was found between nutrition knowledge and health status as measured by biochemical tests. The strongest evidence for the positive effect of nutrition knowledge on health status is provided in an evaluation of several sources of nutrition and health education in Iloilo province in the Philippines. A study done by the Harvard Institute for International Development in collaboration with the University of the Philippines at Iloilo found that nutrition knowledge of mothers was significantly and positively related to the health status of their children, independent of the effects of other socio-economic factors [31].

Case-studies

This section presents brief case-studies of three experimental development communications projects in which health statistics have been used in the evaluation as one measure of effectiveness; for none of the projects were the health statistics the only, or even the major, measure of effectiveness.

Two of the projects, a radio nutrition education campaign by Manoff International, Inc., in the Philippines, and the Stanford Three-community Study in California, were mass media-based non-formal health education projects. The Alaska telemedicine satellite demonstration used mass media for health consultations at a distance.

Manoff radio nutrition education in the Philippines

Manoff International Inc., a United States-based advertising firm recently undertook two radio nutrition education projects, one in Nicaragua and one in the Philippines. The projects were funded by the United States Agency for International Development (USAID), and were designed to test the value of the reach-and-frequency technique, which has been successful in commercial advertising, for community nutrition education. Reach and frequency involves broadcasting short 'spots' over radio or television in which the same simple message is presented repeatedly. The technique relies on the regular programming to attract its audience.

In the Philippines, the Manoff nutrition education project was undertaken jointly with the National Media Production Center of the Philippines. Upon the recommendation of the Philippines National Nutrition Council, the target audience chosen comprised mothers of infants under 12 months, and the messages promoted both introduction of breast-milk supplements by 6 months of age and enrichment of weaning foods with oil, chopped fish and green vegetables. Six one-minute mini-dramas were produced in which a grandmother, having heard about the need for high-quality weaning foods for infants 6 months and older, explains this new feeding practice to her somewhat sceptical daughter.

These six radio spots were broadcast in Iloilo province in the Philippines from October 1975 to October 1976. Radio time was donated through the National Media Production Center and the Philippines Broadcasters Association. The broadcasts were more frequent during the first months of the project, and less frequent towards the end, but an average of three to four one-minute spots were broadcast daily. Approximately 45,000 target mothers lived in the reception area of the co-operating radio stations, most on small rice paddy farms. For a more detailed description of both the community and the project, the interested reader is referred to the Manoff International Inc. final report [32].

The radio nutrition education campaign was evaluated both by Manoff International Inc., itself, as part of its contract to USAID and by the Harvard Institute for International Development in the United States in collaboration with the University of the Philippines College, Iloilo (the HIID/UP Iloilo evaluation) [31].

The Manoff evaluation was based on interviews to determine the impact of the messages on knowledge, attitude and methods of feeding

infants 6 to 12 months old. These interviews were conducted in approximately 1,000 households (including some without radio receivers) before the broadcasts began, after six months and after one year. In brief, the Manoff evaluation found that after a year almost 75 per cent of the women interviewed could recall meaningful portions of the messages, the percentage who believed that adding oil to *lugaw* (the weaning food specified for enrichment in the messages) was good for infants increased from 15 per cent to 74 per cent, and the percentage who thought that adding oil to *lugaw* caused loose bowels decreased from 48 per cent to 6 per cent. The Manoff evaluation also included measures of self-reported behaviour. Several different questions were asked concerning the amount and combination of ingredients added to enrich *lugaw*, but in general the Manoff evaluation found a 10 to 25 per cent increase in the mothers who reported enriching their infant's *lugaw*. One additional interesting finding was that most of the positive effects occurred during the first six months of the project; there was little change in response patterns during the second six-month period.

The HIID/UP Iloilo evaluation attempted to go beyond the Manoff evaluation in several ways, in particular by measuring the weights of infants to determine if enrichment of *lugaw* was related to increases in weight. This evaluation was done at the same time as the last interview of the Manoff evaluation; 100 mothers of infants 6–15 months old were selected from among households that had heard the message but had not been interviewed as part of the Manoff evaluation. The particular message of the nutrition education programme selected for evaluation was the message advocating adding oil to *lugaw* because lack of calories was believed to be the most serious nutritional problem for children in the 6–15-month age group. The households included in the evaluation were selected to include fifty mothers who reported that they did not add oil to *lugaw*, and fifty who reported that they added at least some oil once a week. In addition to weighing infants on a portable scale, the interviewer for the HIID/UP Iloilo evaluation asked mothers about the quantities of various foods they had fed their infant in the previous twenty-four hours, and questions to assess their nutrition knowledge. Various socio-economic characteristics were also recorded.

The HIID/UP Iloilo study found no significant difference between the average weight for age of the infants who were fed oil-enriched *lugaw* at least once a week and those who were not (see Table 1). There are several possible reasons for this, and consideration of these reasons illustrates the care that must be taken in interpreting health statistics as a measure of effectiveness in evaluating a project such as this one.

The most probable reason for the finding of no significant difference is that insufficient calories were provided; an average of only half a teaspoon of coconut oil was added to each serving of *lugaw* (providing twenty to twenty-five calories) and *lugaw* was fed to most infants only a few times a week. Several other rice foods were also fed as supplements

TABLE 1. Average weight for age[1] of infants given oil-enriched or not-oil-enriched *lugaw* for different age groups

Age in months	*N*	Type of *lugaw* fed to infant			
		Oil-enriched[2]	*N*	Not-oil-enriched	*N*
6–9	50	87.3 (12.3)[3]	22	92.9 (14.9)	28
10–12	28	86.1 (16.8)	10	87.9 (13.7)	18
13–15	22	80.2 (10.2)	9	76.2 (7.9)	13

1. For each infant, their weight as a percentage of the median weight for that age group according to a Philippine standard was calculated, giving a weight for age.
2. The *lugaw* fed to infants in this category was enriched with an average of one-half teaspoon of coconut oil per serving. In either group the *lugaw* may have been enriched with other foods.
3. Numbers in parentheses are one standard deviation.

Source: This table is adapted from Table 18, p. 46, of the HIID/UP College, Iloilo, 'Evaluation of the Manoff International Nutrition Education Radio Advertising Campaign in Iloilo, Philippines, October 1975–October 1976', by Marian F. Zeitlin and Candelaria Formación. Harvard Institute for International Development, Cambridge, Mass., 1978 (unpublished manuscript).

to breast milk, but unfortunately the radio messages had only specified that *lugaw* be enriched, due to the incorrect assumption that *lugaw* was the predominant supplement fed to infants in this region of the Philippines. It is also possible that the infants whose mothers added oil to *lugaw* were those who were growing less well at the beginning of the radio project, and that the finding of no significant difference between the two groups of infants at the end of the project indicates a positive effect of the educational messages. Unfortunately, the HIID/UP Iloilo study does not include both pre- and post-project weights. A third possible explanation of the finding of no significant difference between the average weights of infants in the two groups relates to the basic assumption of the message. It is assumed that the low weight for age of infants 6 to 15 months old in Iloilo province is due to lack of calories and, therefore, that earlier introduction of supplementary foods and enrichment of those supplementary foods should improve growth. However, the cause of the poor growth could be due to diarrhoea caused, in part, by the introduction of supplementary food and, therefore, we could not expect to find the programme having a positive impact on the weight for age of the infants.

Stanford Three-community Study

From the autumn of 1972 through the autumn of 1974, researchers from Stanford University's departments of medicine and communications, with funding from the United States Public Health Service and the National Institutes of Health, designed and implemented a com-

munity health education project to reduce risk factors in cardio-vascular disease. The target population were adults aged 35 to 59 years living in Watsonville, Gilroy, and Tracy, three semi-rural towns in northern California, and the project has come to be known as the Stanford Three-community Study. Residents of both Watsonville and Gilroy were exposed to a bilingual (Spanish and English) mass-media non-formal health education campaign, which included the use of radio and television programmes, newspaper articles and advertisements, posters and direct mail messages. The third town, Tracy, provided a control community. No attempt was made to design the experiment to compare the effectiveness of the different media used, but a comparison was made between subjects who were exposed to media alone, and a sub-sample of high-risk subjects in Watsonville who also received intensive face-to-face instruction.

The overall objective of this health education project was to reduce cardio-vascular disease by changing life-styles that increase the risk of the disease. Specific messages provided instructions for those who were overweight to increase daily exercise and to adopt new dietary habits so as to reduce body weight through caloric restriction. Cigarette smokers were educated on the importance for stopping or reducing cigarette consumption, and instructions were given on how to do this. The nutrition messages were directed not only at reduction of total caloric intake, but also at decreasing total cholesterol consumption and increasing the ratio of unsaturated to saturated fats consumed.

Because of its experimental nature, evaluation of the effectiveness of the educational messages was an integral part of the Stanford Three-community Study. Most of the evaluation results were based on three surveys; the first was done two months before the media campaign began, the second at the end of the first year of the project, and the third at the end of the second year [33]. Effectiveness of the nutrition education messages was based on three measures: changes in knowledge, self-reported changes in dietary habits and changes in plasma cholesterol level, which is one of the well-established risk factors associated with the development of cardio-vascular disease. The evaluation found a strong correlation between magnitude of educational input and magnitude of increase in knowledge of dietary risk factors. At the end of the first year of the project, the control community showed an average increase of only 8 per cent in knowledge (the sole intervention in that community was provision of a free physical examination each year). The community with exposure to mass-media education alone showed an average 35 per cent increase in knowledge, and the community in which high-risk individuals received intensive face-to-face instruction showed an average of 46 per cent increase in knowledge. The actual sub-group that received the face-to-face instruction showed a 74 per cent increase in knowledge.

One component of the evaluation concerned the effects of the project on fat consumption [34]. This evaluation was based on a specially

developed ten-minute survey, which used forty-seven questions to characterize the average dietary behaviour of the respondent, and on blood specimens which were taken at each survey to determine cholesterol and triglyceride levels. As far as self-reported dietary behaviour was concerned, all communities showed a decrease in average milligrams of cholesterol consumed per day. However, the decrease was small in the control community and much larger in others. Most of the reported decrease in consumption of cholesterol and saturated fat occurred during the first year of the project, but there seemed to be some tendency for the participants exposed only to mass-media education to continue to report decreased consumption while the group with intensive instruction reported slightly increased average consumption of fat during the second year. Based on these measures of self-reported dietary behaviour, the educational intervention was judged to have been effective, and the use of mass media alone was judged to have been as effective as mass media plus face-to-face instruction.

The health status statistic used to measure effectiveness in this mass-media health education project was serum cholesterol level. Not only was it possible to compare changes in serum cholesterol among the three communities (see Table 2), but the evaluators also compared the actual

TABLE 2. Change in serum cholestorel levels between the first and second surveys by education group

Education group		Mean cholesterol level at survey 1 (mg.%)[1]	Observed change in cholesterol level from surveys 1 to 2 (mg.%)	Adjusted change in cholesterol level from surveys 1 to 2[2] (mg.%)
Face-to-face plus mass-media instruction (Watsonville)	Men	226.3 (6.0)[3]	−0.5	− 7.3
	Women	230.4 (6.4)	−2.9	−10.4
Mass-media messages only (Watsonville)	Men	214.4 (3.3)	+0.1	− 6.3
	Women	209.4 (3.4)	+5.3	− 1.0
Mass-media messages only (Gilroy)	Men	214.8 (3.0)	−0.4	− 6.8
	Women	210.3 (2.6)	+0.4	− 5.9
Control group (Tracy)	Men	210.7 (2.8)	+6.9	+ 0.6
	Women	207.5 (2.8)	+8.9	+ 2.7

1. Milligrams of cholesterol per 100 millilitres of blood.
2. Because the method of taking blood samples at survey 1 was thought to have biased downwards the cholesterol levels observed at survey 1, an adjustment was made in those cholesterol levels and the change between the adjusted levels at survey 1 and the observed levels at survey 2 was calculated.
3. Numbers in parentheses are one standard deviation.

Source: This table is adapted from Table 3, p. 831, of M. P. Stern, J. W. Farquhar, N. Maccoby, and S. H. Russell, 'Results of a Two-year Health Education Campaign on Dietary Behavior—The Stanford Three-community Study', *Circulation*, Vol. 54, No. 5, p. 826–33, 1976.

changes with the changes that would have been predicted by the reported changes in diet. In general, the evaluation found that during the first year of the project, average cholesterol levels dropped, or at least remained the same, in the groups exposed to the health education messages, while the average cholesterol levels of the control group increased. However, the decreases in cholesterol levels predicted by the reported dietary changes were significantly larger than the observed decreases. Interpretation of these results is somewhat complicated by the fact that the blood samples were taken at the first survey under different conditions from those of the second survey, and the medical members of the evaluation team felt that the cholesterol levels obtained at the first survey were biased downwards; for this reason, both observed change in cholesterol level and adjusted change in cholesterol level were presented. Another difficulty with interpretation of changes in serum cholesterol level is that there is known to be considerable daily variation in these levels, and the small changes found in the evaluation of this project may not be biologically significant. None the less, the changes in serum cholesterol level are, for the most part, in the same direction as the changes in reported dietary intake, and thus they provide additional support for the claims of effectiveness based on the behavioural measures.

Alaska Telemedicine Satellite Project

Although it was a health service support project, rather than a nonformal health education project, a brief discussion of the Alaska Telemedicine Satellite Project will serve both to illustrate another way in which communications technology can be used in the development of the health sector in low-income communities, and to provide another example of how health status measures can be used to measure effectiveness. A detailed discussion of both the project and its evaluation can be found in the final report of the evaluation, which was done by the Stanford University Institute for Communications Research [35].

During 1974 and 1975, a biomedical demonstration was carried out in the Tanana Service Unit of the Alaska Area Native Health Service using the ATS-6 satellite; the project was sponsored by the US Department of Health, Education and Welfare. Both television and radio channels were made available three hours a week during a nine-month period for consultation. Village health aides consulted with primary care physicians in Tanana, and those physicians in turn used the system to consult specialists in Anchorage. One of the components of the evaluation of this project was an attempt to determine the effects on the medical outcomes of patient treatment of this capacity for consultation with experts. The Tanana primary care physicians filled out a teleconsultation form for each video, audio, or telephone consultation indicating their judgement of the importance of the consultation to the medical outcome; at the end of the project it was determined that about half the consultations had a prob-

able effect in preventing future patient disability, and that 2–3 per cent of the several hundred consultations were probably life-saving. These physician estimates of effect on medical outcome for each teleconsultation serve as a proxy for morbidity rates. Had the project continued longer and had periodic morbidity surveys been possible, it would have been appropriate to look at differences in morbidity, either among communities or over time, as a measure of effectiveness for such a project.

Conclusions and recommendations

Although only a small fraction of mass-media health and nutrition education projects have been evaluated, and not all of these evaluations have been based on reliably gathered data, the information currently available suggests strongly that mass-media campaigns can reach large numbers of people (including those who are illiterate and those who live in rural communities) and can, in a relatively short period of time, change the health knowledge and attitudes of a significant fraction of those who receive the messages.

In the future, it would be more valuable for evaluations of projects in non-formal health or nutrition education to focus on the question of whether such projects (including those using mass media) can make a significant contribution to changing health related behaviours and health status. For the most part, the answers to these questions will come from reasonably large-scale projects, because usually changes in health status can be expected only from long-term health or nutrition education projects, and ones which reach a large number of people.

Health statistics can also be most appropriately used to evaluate the effectiveness of a health or nutrition education project when this aspect of the evaluation has been anticipated during the project design. To the extent that the objectives of the project can be stated in terms of specific and anticipated changes in behaviour and health status, such as increasing the home use of oral rehydration during diarrhoea and decreasing 1- to 4-year-old mortality from diarrhoea, or increasing the use of mixed cereal weaning foods and decreasing the percentage of 2-year-olds with low weight for height, both the effectiveness of the education project and the quality of the evaluation are likely to be improved. The evaluations of the Manoff radio nutrition education project and the Stanford Three-community Study suggest that, for the most part, large behaviour changes will be necessary before significant changes in health status can be expected.

The main reasons for using health statistics to evaluate certain development communications projects, such as mass-media health and nutrition education projects, are the following:

The outcomes being measured are of great interest to those in the health

sector; most health researchers, government planners and funding institutions accept the social importance of significant changes in mortality, morbidity, anthropometric measures or biochemical tests.

Even if significant changes in health status are not found, the direction of change in measures of health status can assist in interpreting changes in educational outcomes.

The use of health statistics as a measure of effectiveness will make it possible, in some cases, to compare the cost-effectiveness of health or nutrition education interventions with other public health interventions.

However, there are also important disadvantages to the use of health statistics as a measure of effectiveness in evaluating non-formal health or nutrition education projects; in particular, the following should be kept in mind:

Other socio-economic and disease variables will affect health status along with any effects of the education project, so the evaluation design must take these into consideration through appropriate control sites or variables.

Some health statistics can be obtained only by using specialized techniques, and the costs of buying the equipment and training field workers may increase considerably the expense of the evaluation.

While the significance of changes in health status is more widely accepted than the significance of changes in health knowledge or attitudes, it is quite possible that changes in health outcomes will be measured that have statistical significance but questionable biological or social significance.

In summary, then, we can conclude that a decision to include health statistics as a measure of effectiveness in the evaluation of mass-media health or nutrition education projects must be considered carefully. The choice of which effectiveness outcomes are appropriate to measure will depend on (a) the objectives of the project, (b) the resources available for evaluation, and (c) the decisions that will be based on the evaluation. Often it will be inadvisable to attempt to measure changes in health status because the education project was designed to reach only a small number of people, or was a short-term campaign. In addition, the specialized methodology may make health status measures costly to obtain and even once obtained, they may be difficult to interpret due to the influence of other variables in addition to the education intervention. On the other hand, since the ultimate objective of a non-formal health or nutrition education project is to improve health status, it would be valuable to know whenever possible if such an improvement had occurred.

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Case-studies

Cost analysis of primary education by television in the Ivory Coast[1]

J.-C. Eicher and F. Orivel

Introduction

In 1971, the Ivory Coast embarked on a reform of primary education, the principal feature of which was the introduction of television into the classroom. The reform also included the provision of relevant printed matter and the reorganization of teacher training.

The reform had several objectives, but its two main aims—which were complementary—were to make it possible to achieve 100 per cent enrolment in primary education and to provide an education appropriate to the characteristics and needs of society in the Ivory Coast. In theory, the methods employed were to make it possible to reach these objectives at a lower cost than by relying on the traditional approach. Among other things, it was thought that 'television teachers' would be trained more quickly than ordinary teachers and could be paid at a lower rate.

Several research workers have already examined the costs of this experiment. Châu[2] tried to estimate *ex ante*—or forecast—costs; Jamison and Klees[3] had some observed data available but their study is mainly

1. This case-study was written in the early stages of the preparation of this volume. Though slightly outdated it remains relevant.
2. Ta Ngoc Châu, 'Ivory Coast: The Cost of Introducing a Reform in Primary Education', *Educational Cost Analysis in Action: Case Studies for Planners*, Vol. 2, p. 11–61, Paris, Unesco/IIEP, 1972.
3. D. T. Jamison and S. Klees, *The Cost of Instructional Radio and Television for Developing Countries*, Washington, D.C., Educational Resources Information Center/Stanford, Calif., Institute for Communication Research, Stanford University, 1973.

based on forecasts. On 19 March 1976, the Ministry of Education's Service Autonome des Études Générales de Planification et des Études Statistiques, together with the Directorate of Development Studies of the Ministry of Planning, published a fairly detailed document on unit costs in 1975, but it did not deal with the past or the future. Unfortunately, it is difficult to compare these studies with each other and even more difficult to compare them with cost studies carried out elsewhere.

We shall therefore try to give a complete picture, set out as clearly as possible, so that every administrator, planner, economist and policy-maker will be able to find the information he or she needs. At the same time, we shall try to provide for comparison with the findings of the Klees-Jamison study.

We shall begin with a detailed account of the system's structure and the costs entailed, emphasizing the assumptions made concerning its development. We shall then proceed to a more thorough analysis of economic and financial problems by examining the costs by contributor and the unit costs.

Part 1. Development of primary education in the Ivory Coast, 1971–90

In order to situate the problem, we start by recalling the general organization of the Ivory Coast's primary education system and by analysing the development of pupil flows within that system. We shall then look into costs. To avoid all ambiguity over the concepts being used, we shall first classify the costs and then proceed to a detailed study of the various elements of this classification. The second section will deal with their breakdown in accordance with other criteria and will provide an interpretation of observed or presumed developments.

Organization and development prospects of primary education by television

The Ivory Coast's new school system was introduced in September 1971 for pupils beginning their first year of primary education (i.e. CP 1), following a period of meticulous preparation between 1968 and 1971 by Ivory Coast primary-education officials in collaboration with France and the relevant international organizations.

These pupils then passed through the various primary classes, CP 2 in 1972, CE 1 in 1973, CE 2 in 1974, and CM 1 in 1975. When the 1976 school year opened, they began their final year of primary education (CM 2) and, at the end of the 1976/77 school year, the first cohort of

children taught entirely by means of television from the CP 1 level will be leaving primary education.

As well as these television pupils there are two other categories of schoolchildren, those in traditional public education and those in private schools. It is intended that the television scheme will gradually take in the majority of pupils from the traditional public sector as the television network is extended to cover the whole of the Ivory Coast. Only a very few sparsely populated zones where the cost of coverage is prohibitive will be unaffected.

General organization

Production. The production department is located in a former school at Bouaké. The buildings house the teams responsible for the subject-matter of both the television programmes and the printed materials to accompany them, the production teams and the training unit for the television schoolteachers. These divisions come under a general administrative department and share various supporting services such as transport and garage, maintenance, store and a multi-media library. The division concerned with printing the documentary materials is located in separate premises.

All these departments are occupying temporary accommodation on a provisional basis. The Klees-Jamison report suggested that the premises could have been retained permanently, thereby saving a great deal of money, but for various reasons the opposite solution prevailed and new buildings are now being put up in Bouaké.

These buildings, financed by a World Bank loan, will house all the departments from the old site as from 1977. It is still not clear what will happen to the present buildings but there is talk of their being shared by the Ivory Coast Radio and Television (RTI) and the department which handles training for the school television project. This uncertainty complicates the task of estimating net future costs.

Hitherto, the production services were managed in such a way that the various functions could not be costed with accuracy, thus obliging us to make many assumptions. In the past year, however, DOGE[1] has been making a great effort to rationalize matters, and future attempts at calculating costs will be less troublesome and more reliable.

Reception. Without going into detail, the programmes are broadcast by the RTI network. They are sent from the Bouaké centre to Abidjan and then retransmitted to the country as a whole.

Each school class has a television set of a single standard model specially designed for a tropical climate. It uses little electricity (less than

1. Division d'Organisation de la Gestion de l'Éducation (Division for the Organization of Educational Management).

40 watts) and can be serviced by semi-skilled staff thanks to a system of replaceable modules.

The previous report by Klees and Jamison discussed whether a television set should be provided for each class (A) or for two classes (B). B is less costly but calls for a great deal of movement between classrooms since the programmes last about ten minutes and are then used for about an hour as the basis for work before the next broadcast. The B system would therefore only work if the pupils of each class were taken every hour to the classroom with the receiver.

It was thus decided to use (A) for the first five years of school television, and though more costly it made things easier for the pupils.

The architectural department of the Ministry of Education is at present examining a method of fixing the set on a pivoting base so that it can serve two adjacent classrooms without the pupils having to move. The technical obstacles to this idea have not yet all been overcome but it is a reasonable assumption that this system will, at some future date, reduce costs considerably and we shall endeavour to take it into account.

The main reception problem concerns the electricity supply. As the Ivory Coast grid only reaches some 15–20 per cent of the sets now in use, an independent power source has had to be found. Plans to extend the grid will probably not improve this situation by 1990 since the expansion of the television school system is mainly occurring in the non-electrified zones.

The result is that 80–85 per cent of the television sets are run off alkaline batteries, which have so far proved cheaper than any other form of independent energy, such as electric generators, solar cells, wind-power and so forth. Foreseeable advances in solar energy technology, however, make it possible to envisage the gradual supplanting of the very costly alkaline batteries by solar cells, but progress is slow and no significant savings can be expected before the beginning of the 1980s.

In the short term it is planned to manufacture the batteries locally instead of importing them. This is unlikely to reduce unit costs very much but it would save foreign currency.

The Compagnie Africaine de Télévision (CATEL), a private company based in Abidjan, has been entrusted with installing and servicing the receivers, masts and aerials. It has organized mobile teams which visit the schools once a month, each team following a pre-arranged circuit. If a breakdown occurs between visits, breakdown teams with radio-equipped vehicles can be called out and quickly reach the place concerned.

This system seems quite reliable. As breakdowns average only one per set every two years, those in charge of the system are thinking of extending the planned average life of the sets to seven or even ten years. In addition, a new model is at present being planned that would require almost no servicing and whose breakdowns could be put right by the teachers themselves.

Primary-education enrolments

In 1975, a little over half the Ivory Coast children in the 7–12-year age group were at school.

The growing provision of schooling may be gauged from the planned expansion of the access rate to the CP 1 level, shown in Table 1.

The expansion should lead to almost total enrolment in 1990, when the 1984/85 CP 1 entrants will be completing their primary education. After allowing for drop-outs, the enrolment rate for the 7–12-year age group is planned to average 95–96 per cent at that date. The proportion of television school pupils will rise from 54 per cent in 1976/77 to about 90 per cent in 1990 (public sector), the cost of providing television cover for the remaining 10 per cent being still too high.

One of the most radical innovations accompanying the reform of primary education has been the concern to put an end to the catastrophic repetition and drop-out rates which were a feature of the traditional system. In the television secteur today the average repetition rate is under 10 per cent, as against 28 per cent formerly. It is expected to drop still further, to 7 per cent in CP 1 and to 5 per cent in CP 2, CE 1, CE 2 and CM 1.

The drop-out rate at the end of each year of studies has also fallen a lot, and present targets provide for a maximum of 1 per cent.

Recent pupil flows in television schools. In Table 1, the pupils in a given class comprise three categories: those arriving from the preceding television class; repeaters; and those coming from a non-television class.

TABLE 1. Pupil numbers in television classes from the start of the system to 1975/76

Year	CP 1	CP 2	CE 1	CE 2	CM 1	Total
1971/72	22,000					22,000
1972/73	38,000	20,000				58,000
1973/74	50,693	37,404	19,231			107,328
1974/75	57,239	49,094	36,010	18,628		160,971
1975/76	74,569	56,819	47,984	34,355	17,484	231,211

Although it does not happen here, it is theoretically possible to have more pupils in the next higher class if the entrants from outside sources more than make up for net losses from repeaters and drop-outs.

Forecast enrolments, 1976–90. The National Plan includes projections of enrolments up to 1990, known as Projedor (computer-based projections for education). Several assumptions, numbered 1 to 10, have been tried out. They vary according to the estimates made concerning the maximum

size of classes and drop-out rates, particularly at the CM 2 level. In actual fact, automatic promotion will bring into CM 2 large numbers of children aged 11–12 years who are ill-suited to secondary education and who might well spend a long time at CM 2 level—up to the age of 15—in the hope of eventually gaining admission to the first year of secondary education. A 'waiting-room' of this kind is clearly undesirable both psychologically and economically, and alternative arrangements will have to be made for them.

It is a difficult business to choose between Projedor projections since their assumptions are all equally plausible. In normal circumstances they should all be examined and the probable costs worked out in each case. In our view, however, the differences between their figures for future enrolments are, on the whole, smaller than the margin of error in our costing. In Projedors 3, 5 and 10, for example, which are generally considered as good scenarios, the total number of pupils at primary television schools in 1990, the last year of the projections, does not vary by more than 20,000 out of 1.5 million, i.e. 1.2 per cent. We would be highly satisfied to achieve cost estimates with this margin of error.

TABLE 2. Forecast television school enrolments by class and by year up to 1990

Year	CP 1	CP 2	CE 1	CE 2	CM 1	CM 2	Total
1976/77	96,586	73,508	55,304	46,951	33,346	21,550	327,245
1977/78	113,066	96,381	72,239	54,370	46,317	46,196	428,569
1978/79	129,618	112,901	97,254	71,383	53,954	66,218	431,328
1979/80	140,404	124,716	110,892	94,954	70,770	77,628	619,364
1980/81	152,978	135,249	122,756	109,047	93,714	98,565	712,309
1981/82	165,612	147,501	133,271	120,962	108,362	124,465	800,173
1982/83	179,230	159,738	145,313	131,322	120,331	139,912	875,846
1983/84	198,451	172,877	157,418	143,160	130,661	148,550	951,117
1984/85	210,240	191,217	170,374	155,130	142,409	155,680	1,025,050
1985/86	227,696	202,980	188,261	167,907	154,366	165,132	1,106,342
1986/87	238,182	219,629	200,214	185,360	167,093	176,586	1,187,064
1987/88	251,043	230,109	216,461	197,469	184,263	188,947	1,268,291
1988/89	262,103	242,464	227,124	213,346	196,675	203,484	1,345,196
1989/90	273,393	259,257	239,272	224,163	210,378	217,431	1,417,894
1990/91	285,144	264,183	250,024	236,123	221,231	230,369	1,487,074

Source: Projedor 9.

Consequently, selecting one scenario rather than another does not, in the end, have much impact on the cost projections and we have arbitrarily chosen Projedor 9 (Table 2) which in fact reflects an assumption that we regard as desirable, namely, a large number of drop-outs in CM 2.

These projections assume that, once the new DIGO transmitters are

in service, at the start of the 1976 school year, those covering the south-west in 1977 and the centre-west in 1978, 88 per cent of CP 1 pupils in public education will go into a television class for the 1978/79 school year.

As we have seen, 10 per cent of pupils will not be covered by the television system. It is thus fair to say that, by 1978, the school television programme will have reached its 'cruising speed' as far as CP 1 is concerned. Further increases in enrolments will be due to population increases (larger age groups) or to higher enrolment rates.

The proportion of private schooling is expected to fall considerably, as Table 3 shows.

TABLE 3. Forecast enrolments in State television schools, State non-television schools and private schools respectively

		State non-television	State television	Private	Total
1975/76	enrolments	316,172	231,211	125,590	672,973
	percentage	47.0	34.4	18.6	100.0
1980/81	enrolments	133,830	714,032	125,167	974,629
	percentage	13.8	73.4	12.8	100.0
1982/83	enrolments	119,475	888,118	116,562	1,124,155
	percentage	10.6	79.0	10.4	100.0

The next four years will confirm the capital importance of primary television schools, the number of which will rise from one-third to nearly three-quarters of the total. In terms of enrolments, this means that the number of pupils in such schools will triple. Private education will still provide for a little over 100,000 children, which is just under 20 per cent of the total today but will be only about 10 per cent in six years' time.

During the period covered by the next national plan, therefore, school television is going to go through a decisive stage and one that will be difficult because it will precede the substantial reductions in cost that we think can be achieved from 1980 onwards.

New television classes. New classes depend on the number of pupils to be provided for (see Table 2) and on the accepted teacher/pupil ratio; that is, the number of children per class. This has to be worked out for each year of study since the children of a CE 1 class, for instance, cannot be transported from one school to another in order to make up for drop-outs at the end of CP 2. Only two classes leave some room for manœuvre: CP 1, which determines the number of children in subsequent classes and for which a gradual reduction in the number of children per class is contemplated (Projedor 9 has 46.5 pupils in 1976/77 and 42.6 in 1990/91), and CM 2, which runs the previously mentioned danger of having pupils for several years in succession because they have failed the entrance examination to secondary education. To avoid overcrowding in these

classes, Projedor 9 assumes the maximum size to be 50 in 1977, gradually falling to 43.4 in 1990.

In brief, the average class size according to Projedor 9 should fall from 43.72 in 1976/77 to 41.48 in 1990/91.

When the effect of Projedor 9's assumptions on the number of television classes is compared with that of Projedor 3's, it can be seen that Projedor 9 provides for more classes initially, then fewer class over a period of seven years, and once again more classes until 1990; but the final overall difference is only 413 classes, or 1.13 per cent (Table 4).

TABLE 4. Total numbers of television classes

Year	CP 1	CP 2	CE 1	CE 2	CM 1	CM 2	Total	New classes	Difference as compared with Projedor 3
1971/72	457	—	—	—	—	—	457	457	//
1972/73	937	457	—	—	—	—	1,394	937	//
1973/74	1,129	937	457	—	—	—	2,523	1,129	//
1974/75	1,324	1,129	953	457	—	—	3,847	1,324	//
1975/76	1,608	1,245	1,081	825	423	—	5,182	1,335	//
1976/77	2,077	1,717	1,283	1,196	822	438	7,533	2,351	+ 211
1977/78	2,469	2,178	1,730	1,292	1,171	925	9,765	2,232	+ 47
1978/79	2,880	2,579	2,228	1,762	1,277	1,380	12,106	2,341	− 157
1979/80	3,134	2,882	2,566	2,222	1,730	1,688	14,222	2,116	− 199
1980/81	3,430	3,134	2,874	2,565	2,218	2,145	16,366	2,144	− 213
1981/82	3,730	3,436	3,132	2,864	2,559	2,764	18,485	2,119	− 26
1982/83	4,055	3,730	3,434	3,123	2,851	3,110	20,303	1,818	− 271
1983/84	4,510	4,059	3,732	3,433	3,114	3,316	22,164	1,861	− 280
1984/85	4,800	4,510	4,056	3,738	3,407	3,491	24,002	1,838	− 201
1985/86	5,223	4,810	4,504	4,066	3,711	3,720	26,034	2,032	+ 108
1986/87	5,488	5,230	4,813	4,510	4,036	3,995	28,072	2,038	+ 117
1987/88	5,811	5,505	5,229	4,828	4,472	4,295	30,140	2,068	+ 221
1988/89	6,096	5,829	5,513	5,242	4,797	4,646	32,123	1,983	+ 142
1989/90	6,388	6,118	5,836	5,535	5,157	4,987	34,021	1,898	+ 63
1990/91	6,694	6,413	6,128	5,859	5,449	5,308	35,851	1,830	+ 25

Source: Projedor 9.

It is worth noting in passing that the Ivory Coast authorities are much more anxious to have a large quantity of accurate high-quality data than is usually the case elsewhere.

In recent years, then, the programme has expanded tenfold, from 457 classes in its first year to more than 5,000 in 1975/76. It will triple again in the next five years, to nearly 17,000 classes in 1980/81, and then double once more in the ten years up to 1990 to reach a total of some 36,000 classes. This, in outline, is how the system is expected to develop.

If the rate of growth slows down, the actual number of new classes does not fall but remains steady at about 2,000 classes per year throughout

the period in question, a figure which has not yet been achieved for any of the new school years since the programme started.

This means that, in absolute terms, there will be no respite during the entire period; indeed, the overall *stock* of facilities needing to be maintained or replaced will be increasing all the time.

Reception costs

From this section onwards, our analysis of the costs of the major functions is based on data gathered locally from the various departments concerned, whom we would like to thank for their courtesy and diligent co-operation. Special mention should be made of the document, dated 19 March 1976, produced jointly by the General Planning Department of the Ministry of Education and the Ministry of Planning, which provides a detailed analysis of costs in 1975.

We shall examine in succession: the cost of television sets and related items; the cost of the power supply; and the cost of maintenance.

Television sets and related items

Television sets are purchased to cover the needs of classes but also for teacher training, the central administration, and the Bouaké production centre. A certain number are stolen, estimated by the Klees-Jamison report at 1 per cent per year. In fact, the number of sets lost has been as shown in Table 5.

TABLE 5. Number of television sets lost

	1971	1972	1973	1974	1975
Stock	1,332	2,432	4,348	5,848	6,848
Missing	1	26	17	20	17
Percentage missing	Σ	1.1	0.4	0.35	0.25

As the number missing has dropped from 1 per cent when the project began to 0.25 per cent today, it does not seem to us very important to take it into account when forecasting since it will, without any doubt, have less impact than uncertainty about the real cost of television sets over the next fifteen years.

The estimated requirements for aerials over the same ten-year period are 10,050, or 1 per 1.6 classes. It should be possible to reduce this to 1 aerial for 2 classes. Here, too, price increases have been excessive, more than tripling from 4,500 francs in 1971 to 15,250 in 1976. The cost has been estimated at 13,000 1975 C.F.A. francs each.

The total ten-year cost per class comes to 37,000 C.F.A. francs for masts and 6,500 C.F.A. francs for aerials, or 43,500 C.F.A. francs

TABLE 6. Number and cost[1] of television sets purchased and installed

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
New sets[2]	1,332	1,100	1,916	1,500	1,000	2,351	2,232	2,341	2,116	2,144	2,119	1,818	1,861	1,838	2,032	2,038	2,068	1,983	1,898	1,820
Reconditioned sets[3]	—	—	—	—	—	—	—	1,332	1,100	1,916	1,500	1,000	2,351	2,232	3,673	3,216	4,060	3,619	2,818	4,212
Total cost[4]	140	105	171	140	96	226	214	353	309	390	347	271	404	391	548	504	588	538	453	580
Accessories[5]	18	20	25	29	36	29	38	47	55	63	71	78	85	93	100	108	116	124	131	138
Masts and aerials[6]	34	36	60	40	63	33	42	53	62	71	80	88	96	104	112	122	131	140	148	156
TOTAL	192	161	256	209	195	288	294	453	426	524	498	437	585	588	761	734	835	802	732	874

1. In millions of 1975 C.F.A. francs. For previous years we have employed the French franc as a deflator, the value of which has changed as follows: price index (1975 = 100): 1968, 60.8; 1969, 65.0; 1970, 68.7; 1971, 72.5; 1972, 76.9; 1973, 82.3; 1974, 90.9; 1975, 100.
2. To simplify matters, we have considered that there were as many new sets as new classes.
3. We have allowed for the replacement of all television sets installed seven years previously. According to the maintenance department, their average life expectancy might be longer. In our view, however, possible gains here would compensate for the fact that we have disregarded the number of sets lost and have not increased the number of television sets installed in places other than classrooms.
4. The total cost is the product of the number of new and reconditioned sets multiplied by 96,000 C.F.A. francs, their 1975 price.
5. Apart from the set itself, there are a certain number of ancillary items for the mains supply, HF chassis, control chassis, cathode-ray oscilloscopes, cable and various accessories, for which we merely give the total annual cost. Their cost per new class has evolved as follows: 1972, 21,344; 1973, 22,143; 1974, 21,903; 1975, 26,966. We have therefore taken the figure of 27,000 C.F.A. francs per new class. As with the television sets, depreciation for these accessories is spread over seven years, thus producing an annual cost per class of 3,857 C.F.A. francs, which we have multiplied by the number of classes.
6. For the first ten years of operation (1971–80) it is planned to install 7,445 masts for a total of 16,677 classes, or 1 mast for 2.24 classes. We think it possible to arrive at a figure of one mast for 3 classes and we use this from 1980 onwards. The cost of masts has increased out of all proportion, rising from 36,900 C.F.A. francs in 1971 to 125,000 in 1976, or 238 per cent in five years. It rose from 80,000 to 125,000 C.F.A. francs between 1975 and 1976, thus making it difficult to calculate the cost of a mast in 1975 C.F.A. francs. We have taken 110,000 1975 C.F.A. francs as the cost of a mast.

altogether; the cost per class per year is therefore 4,350 C.F.A. francs, a figure that was then multiplied by the number of classes.

The total cost of purchasing and installing television sets, about 200 million C.F.A. francs in 1974 and 1975, will quickly reach 400 million francs in 1977 and 800 million francs towards 1985, remaining steady at this level until 1990. The figures assume one set per class which, it will be recalled, was the more expensive alternative for reception costs. Part 2 will examine the probable savings from assuming 1 set for 2 classes.

Power supply

A key factor in the cost of school television is the electricity supply for the television sets. Though 15–20 per cent of them are connected to the mains, 80–85 per cent must at present be run off alkaline batteries.

Problems of method. We shall mention two only:

1. *Problems of accounting for use.* When a school television set is powered by alkaline batteries—that is, in eight cases out of ten—the unit of thirty-two batteries is known to have an average life of 2,000 hours, equivalent to two years of operation at 1,000 hours per year. But other sources show that the time actually spent on school broadcasts is far less and that there exist three other explanations for the set being switched on: for non-formal educational programmes; 'pirate' tuning in to commercial programmes; leaving the set on without the sound between two consecutive school programmes.

   Taking each case in turn, non-formal programmes do not in fact exceed thirty hours a year but the amount of listening to commercial programmes is difficult to estimate; it is, in theory, forbidden but ways are found of getting round the rules. However, it would be very rare for the set in each classroom of a school to be switched on for as much as one hour each evening throughout the year. It is more realistic to halve this figure and thus assume an average of 180 hours 'pirate viewing' per year. This represents, in round figures and including non-formal educational programmes, 200 hours of non-school operation per year. Our conclusion is thus that the television sets are used most by being kept on between two consecutive school programmes, a very widespread practice that many observers have noticed.

   This argument suggests that, out of 1,000 hours per year, school television accounts for 800 and other uses 200.
2. *Changing from alkaline batteries to solar cells.* A few television sets are now using solar cells made in the United States. These cells were not designed for this purpose, with the result that they do not last long, and their unit cost is still very high.

   According to information at our disposal, the technical and economic aspects of the solar cell may be summed up as follows:

silicon solar cells are less apt to corrode than cadmium sulphide ones and would thus appear to be more suitable; changes in the price per watt installed are estimated as follows: 1975: $21 (*source*: Henri Durand, Congress on solar electricity, Toulouse, 1975); 1975: $5 (*source*: ERDA-ISES Congress abstracts, 1975); 1980: $4 (*source*: Centre d'Études Nucléaires, Grenoble, France); 1985: $0.5 (*source*: ERDA); 2000: $0.1 (*source*: IEJE—Grenoble, France).

This price concerns peak power; that is, in the best possible conditions of sunlight. It is estimated that, in 'temperate zones', the peak capacity must be multiplied by seven to obtain a given output throughout the year. Unfortunately there is not enough empirical data to work out a coefficient for tropical regions. In the absence of reliable information but allowing for the fact that there is very probably more sunlight in these regions, if only because of the even length of the day throughout the year, we have cautiously left an adequate safety margin and chosen a coefficient (5.5) only 20 per cent less than for temperate regions. This means that a 40-watt television set requires solar cells with a theoretical capacity of 220 watts.

Estimating the cost. The cost in U.S.$ per watt × 220 (see above) of a solar-cell unit to power a television set for the year 1975: $4,620; 1978, $1,100; 1980, $880; 1985, $110; and 2000, $22.

If these figures are plotted in order to obtain the cost in each year of the programme, the result is as shown in Table 7.

TABLE 7

Year	U.S.$	C.F.A. francs	Year	U.S.$	C.F.A. francs
1979	1,000	250,000	1985	110	27,500
1980	800	200,000	1986	95	23,750
1981	620	155,000	1987	80	20,000
1982	480	120,000	1988	70	17,500
1983	340	85,000	1989	60	15,000
1984	220	55,000	1990	50	12,500

This should be set against the cost of the unit of thirty-two alkaline batteries, 307,200 C.F.A. francs in 1975—a price that can only be expected to remain steady in real terms. Even if the concordant forecasts of American and French research workers in regard to solar energy costs turn out to be over-optimistic, it is more or less certain, that by 1980 at the latest, alkaline batteries will no longer be competitive. This development has important consequences: (a) it is not economically efficient for the Ivory Coast to invest in the local manufacture of alkaline batteries; (b) it will probably serve no purpose to seek the ideal combi-

TABLE 8. *Cost of electrical power supply (in millions of C.F.A. francs)*

		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Batteries	H1: solar cells	72	146	252	309	345	240[1]	336	768	710	1,480[2]	1,145[3]	175[4]	127[4]	81[4]	45[4]	215	181	53	45	37
											7,404[5]	7,384	1,454	1,489	1,470	1,626	9,034	9,038	3,041	3,007	2,934
	H2: alkaline batteries[6]	72	146	252	309	345	240	336	768	710	960	2,628	2,828	3,096	3,334	3,556	3,792	4,010	4,325	4,460	4,678
Battery containers	H1: solar cells	18	20	28	17	18	29	41	44	38	—	—	—	—	—	—	—	—	—	—	—
	H2: alkaline batteries	18	20	28	17	18	29	41	44	38	29	32[7]	37	40	41	40	50	49	53	51	51
Total	H1: solar cells	90	166	280	326	363	269	377	812	748	1,480	1,145	175	127	81	45	215	181	53	45	37
	H2: alkaline batteries	90	166	280	326	363	269	377	812	748	989	2,660	2,865	3,136	3,375	3,596	3,842	4,059	4,288	4,511	4,729
Cost to primary education (80 per cent)	H1: solar cells	72	133	224	261	290	215	302	650	599	1,184	916	140	102	65	36	172	145	42	36	30
	H2: alkaline batteries	72	133	224	261	290	215	302	650	599	791	2,128	2,292	2,509	2,700	2,877	3,074	3,247	3,430	3,609	3,783

H1: assuming that alkaline batteries are replaced by solar cells.
H2: assuming alkaline batteries throughout.

1. Running down stocks—battery stocks were quite high in 1973–75.
2. Obtained by multiplying the unit price of solar cells in 1980 (200,000) by the number of new television classes (2,144) plus half the existing classes whose alkaline batteries are running out (7,111), the product then being re-multiplied by 0.80 (coefficient for proportion of television sets not on the mains).
3. 1981 unit cost (155,000) × existing classes not yet equipped plus new classes × 0.80.
4. New classes × 0.80 × price of solar cells installed in that year.
5. From 1971 to 1975, actual purchases (in 1975 C.F.A. francs). From 1976–80, CATEL and DOGE forecasts (at 1975 prices). From 1981 onwards, replacement costs for half the existing classes with a battery power supply and the cost of equipping all new classes.
6. These figures represent the number of solar cell units to be purchased during the year in question.
7. From 1981 onwards, replacement of battery containers installed ten years previously.

nation of solar cells and auxiliary accumulators for all regions of the Ivory Coast since the relative cost of a battery unit is such that it would soon be worthwhile to over-equip installations with solar cells in order to obtain 40 watts in the least favourable conditions of sunlight. A small battery for night use would be enough.

For the unit of thirty-two alkaline batteries, we have taken the 1975 price, 307,200 C.F.A. francs, as the real cost throughout the period.

Lastly, the average life of the solar cells is estimated at six years.

The most important point to emphasize is that alkaline batteries cost for more than solar cells (100 times more by the end of the next decade). Even allowing for uncertainty over the future cost of solar cells, it is clear that alkaline batteries must be abandoned in the very near future, by 1980 at the latest.

Maintenance

Each year CATEL presents a general bill for servicing the television equipment. This includes wages, vehicle upkeep, petrol and the company's fees, but does not cover the purchase of test equipment or the vehicles themselves.

Our procedure has been, for previous years, to convert the amount actually disbursed into 1975 francs; for 1976–80 we have accepted CATEL's estimates, and for 1981–90 our figures are based on a proportion of 1971–80 costs and the number of schools to be serviced. Unit costs for test equipment and vehicles are regarded as constant throughout the period.

TABLE 9. Total maintenance costs 1971–79
(in millions of 1975 C.F.A. francs)

	1971	1972	1973	1974	1975	1976	1977	1978	1979
Test equipment and vehicles	12.6	20.3	17.8	23.3	31.8	26.0	40.6	36.3	39.0
Installation and maintenance	157.0	308.0	316.0	361.0	362.0	448.0	495.0	544.0	598.0
TOTAL	169.6	328.3	333.8	384.3	393.8	474.0	535.6	580.3	637.0

TABLE 10. Unit maintenance costs 1971–79
(in millions of 1975 C.F.A. francs)

Year	By class	By school	Year	By class	By school
1971	0.371	0.371	1976	0.0647	0.239
1972	0.235	0.350	1977	0.0563	0.228
1973	0.132	0.296	1978	0.0484	0.195
1974	0.100	0.290	1979	0.0444	0.188
1975	0.076	0.244			

Where maintenance is concerned, lower unit costs should be expected because, for one thing, the marginal cost will fall and, for another, television sets needing minimal servicing will be introduced. It is quite possible, however, that labour costs will increase since the wages of CATEL workers are unlikely to remain at their present level over a long period.

On the whole, our view is that all these assumptions probably cause maintenance costs to be exaggerated.

The decreasing average and hence marginal cost, particularly by class, emerges clearly, since a visit to service a single classroom costs almost as much as one to inspect several classrooms in the same school. Figure 1 shows how this series of figures can be plotted to obtain the following forecasts for unit costs per school.

TABLE 11. Forecast maintenance costs

Year	Unit cost per school in C.F.A. francs	Total costs in millions of C.F.A. francs	Year	Unit cost per school in C.F.A. francs	Total costs in millions of C.F.A. francs
1980	180,000	658	1986	150,000	832
1981	175,000	705	1987	150,000	872
1982	170,000	733	1988	150,000	914
1983	165,000	759	1989	150,000	958
1984	160,000	792	1990	150,000	1,041
1985	155,000	816			

Actual costs will probably be lower if a still more reliable model of television set is brought into service. This, however, is still no more than a possibility and it is difficult to know whether the future model will be more costly than the present one. The cost of television sets is, however, regarded as a constant. Thus in the event of a changeover, buying costs would probably rise while maintenance costs would fall.

Table 12 summarizes overall reception costs on the assumption that solar cells will replace alkaline batteries.

It will be observed that total costs rise sharply in the next four years to a peak of about 2,500 million C.F.A. francs in 1980 or three times the figure for 1975. After 1980 they fall rapidly, owing to the introduction of solar cells, to about 1,300 million C.F.A. francs in 1982 and then reach 2,000 million C.F.A. francs at the end of the decade. By the middle of the 1980s, the main item of expenditure will be maintenance, and it might be worth while to reorganize this service. Around 1985, in fact, there could be quite a large number of private televisions, making it possible to call on repairers from the cities, towns and even villages. In addition, the development and introduction of a model requiring very little servicing could be speeded up.

Our conclusion is that, in spite of uncertainty surrounding some of the assumptions, and after a few difficult years (1978–81), a general level

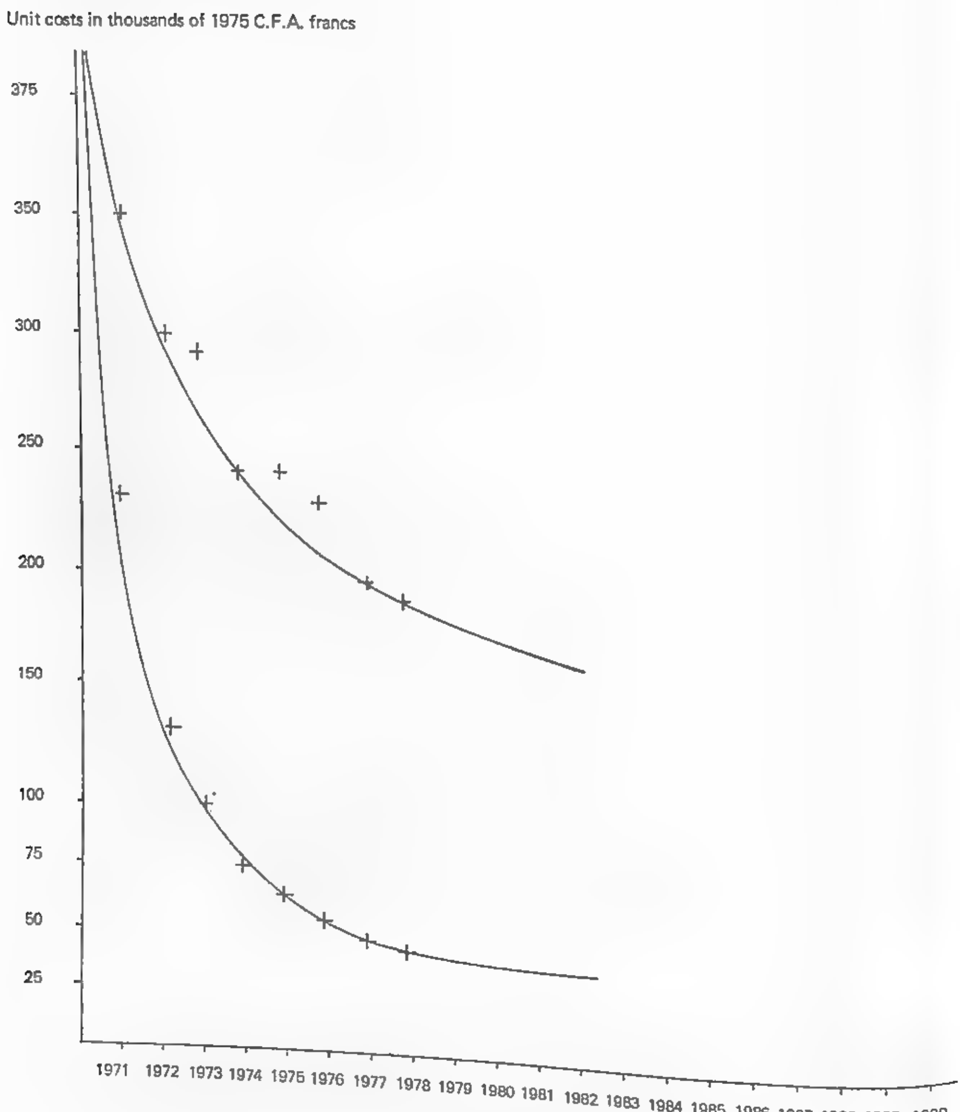

FIG. 1. Evolution of unit costs for maintenance by school and by class.

TABLE 12. Overall reception costs (in millions of 1975 C.F.A. francs)

Year	Television sets, masts, aerials, accessories	Power supply (cost to primary education)	Maintenance	Total
1971	192	72	170	434
1972	161	133	328	622
1973	256	224	334	814
1974	209	261	384	854
1975	195	290	394	879
1976	288	215	474	977
1977	294	302	536	1,132
1978	453	650	580	1,683
1979	426	599	637	1,662
1980	524	1,184	658	2,366
1981	498	916	705	2,119
1982	437	140	733	1,310
1983	585	102	759	1,386
1984	588	65	792	1,445
1985	761	36	816	1,613
1986	734	172	832	1,738
1987	835	145	872	1,852
1988	802	42	914	1,758
1989	732	36	958	1,726
1990	874	30	1,041	1,945

of costs is reached which is perfectly bearable and appears to justify retaining and continuing to develop the school television programme. We would perhaps recommend starting fewer new classes in the three crucial years (1978–81) and making up the lost ground in the three years after that (1982–85).

Production and broadcasting costs

Costing educational programmes for schools raises important problems of method. It has, in fact, already been mentioned that the production services, located at Bouaké, are part of a large centre which, in addition to producing programmes for schools, produces documentary material and provides, through three separate organizations: Centre d'Animation et de Formation Pédagogique (CAFOP), École Normale d'Instituteurs (ENI), Section de Spécialisation en Technologie Éducative (SSTE), for the training of teachers.

Until recently, the accounts of these divisions were kept in such a way that it is not always possible to determine exactly what resources were allocated to each one. A standard management procedure was introduced only a few months ago and it is still too early for this report to draw on these now indispensable innovations.

Discussion with the various officials in charge of the Bouaké centre

left us with the impression that there was a strong tendency for each division to claim its independence. Without going into a detailed analysis of the sociology of organizations, a few brief comments may be made:

There is a historical explanation for all the divisions being at the same centre: PETV[1] was, so to speak, devised 'as it went along'.

Coexistence encouraged somewhat lax administration: the staff enjoyed the obvious advantage of avoiding the rigours of public accountability, of being able to arrange matters among themselves in an atmosphere where a blind eye was turned to abuses, wastage and mistakes.

The much-needed introduction of stricter regulations is drawing attention to the disadvantages—or, from the standpoint of public interest, the advantages—of existing side by side, and could encourage the temptation to split away and become independent;

This temptation generally takes the form of each department claiming the right, for example, to its own studios, vehicles and service staff, in the pious hope of never having to compete for the use of resources;

Such an ideal, that resources will always be at hand, assumes that immobilization costs are nil, which is far from being the case. Instances of over-equipment, due to the fact that it is considered cheaper to buy a second set than to suffer the restrictions of sharing and using equipment in the most rational and efficient manner, have already been observed in the Ivory Coast, and in other countries too. From the micro-economic standpoint, it is easy to explain such occurrences since different officials are responsible for meeting the cost in different cases. But the person responsible for public funds must, of course, put the public interest first.

This is why the natural inclination of senior officials in each department to recommend and seek a complete range of resources, even though they will be under-used, should be resisted.

Returning to the Bouaké centre, which contains several divisions with different outputs but common support services, we are occasionally obliged to cost the use of these resources in a rather haphazard manner. In most cases our estimates are in proportion to direct costs, which are in turn very closely related to staff costs.

As for the evaluation of costs, it should be clearly understood that they depend greatly on the status of the personnel. This is why, in the Unesco publication already mentioned, we suggested describing physical inputs before going on to estimate their monetary value. This is what we shall do here, since change of status alters the monetary cost but not necessarily the physical input. In the case of the Ivory Coast, it would be fair to say, simplifying matters, that the average cost of a foreign technical assistant is at least twice as much as his national counterpart, and that a national government employee costs four times as much as a local casual

1. Programme d'Éducation Télévisuelle (Educational Television Programme).

worker. The process of staffing with 'nationals' is already under way and is, in theory, due to be completed in 1980, and there is a slight trend, the future development of which cannot as yet be forecast, for casual workers to acquire government-employee status. The former process tends to reduce costs and the latter to increase them.

Total number of employees by category

Table 13 shows the number of staff in each category since the programme started.

TABLE 13. Staff categories at the Bouaké centre

	1969	1970	1971	1972	1973	1974	1975
Government employees							
Ivory Coast nationals	—	19	49	60	131	154	173
National casual workers	—	73	75	86	166	200	259
Foreign technical assistants (French, Canadian, Unesco)	13	47	86	114	144	126	133
TOTAL	13	139	210	260	441	480	565

The table does not include persons seconded to DOGE (before 1975 to the Unité de Traitement de l'Information (UTI)), to internal or external evaluation services, to non-formal educational activities or to the Architectural Unit. DOGE and the Evaluation Unit both work for PETV as a whole and not just for the production division; non-formal educational activities are a separate matter and the Architectural Unit would have its uses without PETV.

Clearly, the number of people employed at the Bouaké centre has grown very rapidly and a further seventy posts have been requested for the 1976/77 school year. Present numbers are already far in excess of the initial forecasts.

These requests for additional staff can be partly explained by the fact that the Bouaké centre is getting ready to produce programmes at the secondary level for the moment when the first generation of television learners enter the first year of secondary education in September 1977. This, however, is only one of several possibilities and, what is more, the present report is concerned with estimating the costs of television for primary education only. We shall therefore fix staff requirements at the 1975 level since, from 1977 onwards, the centre will merely have to revise already recorded programmes as all those needed for the six years of primary education have been produced at least once. The staff is probably a little larger than necessary, but it is not possible to state to what extent.

In addition, when assessing the costs, we shall be unable to make a

precise allowance for the process whereby casual workers become government employees and thus increase costs, though this might be counterbalanced by reductions in staff.

Number of employees by division

We shall examine the number of employees in each division for the year 1975/76 (Table 14).

TABLE 14. Staff structure by division

	Technical assistants (France and Unesco)	Technical assistants (Canada)	National government employees	Casual workers	Total
General Directorate and Administration	5	—	38	88	131
Written materials —production	—	13	5	9	27
Written materials —printing	—	13	5	72	90
Education	31	—	46	—	77
Sub-directorate of audio-visual technology	31	—	46	56	133
Evaluation	3	—	8	4	15
Training	30+7	—	25	30	92
TOTAL	107	26	173	259	565

The General Directorate and Administration includes all personnel employed in joint services such as drivers and garage staff, maintenance men and multi-media library staff. The Educational Division is concerned with planning the television programmes and is included under production costs.

Production costs: operation

The operating costs of the production division raise three problems: (a) ascribing a proportion of the cost of Bouaké's joint services to each of the three 'functions' of the centre, i.e. television, written material and training; (b) ascribing a proportion of the cost of central services (Evaluation Unit, DOGE, Architectural Unit) to each sector administered; (c) ascribing purchases of various kinds of equipment and supplies to the three divisions in the absence of accounting procedures allowing them to be traced to the division using them.

For the sake of convenience, we have had to ascribe all purchases of equipment and material for the production of television programmes to the production sector, although some were for television teacher training, which uses a studio and closed-circuit television. The costs of the joint services at Bouaké have been ascribed in proportion to the direct costs of the divisions that use them.

Lastly, central administration costs have been ascribed in proportion

to the direct costs of the various PETV sectors: reception, production, written material and training.

The direct production costs in 1975 for technical assistance and national government employees amount to 286 million 1975 C.F.A. francs, for accommodation for technical assistants,[1] to 62 million (31 million in the Technical Sub-directorate and 31 million in the Educational Division), and for equipment and casual workers, to 190 million, making a total of 538 million.

The joint services and central administration costs in 1975 for national personnel amount to 37 million 1975 C.F.A. francs, for technical assistance to 39 million, for accommodation for technical assistants to 5 million, for equipment and casual workers, to 118 million, and for electricity, water and telephone, 21 million, making a total of 220 million.

TABLE 15. Distribution of the costs of joint services and general administration at the Bouaké centre

	Direct costs (in millions C.F.A. francs)	Percentage	Share of joint services and general administration costs
Written materials	480[1]	37.2	82
Training	273[2]	21.1	46
Production	538	41.7	92
TOTAL	1,291	100.0	220

1. See Table 21: sub-total of direct expenditure.
2. See Table 19: sub-total of direct expenditure.

The cost of central services (excluding the Bouaké centre) for technical assistance is 56 million C.F.A. francs; for accommodation of technical assistants, 16 million; and for equipment and casual workers, 46 million, totalling 118 million.

TABLE 16. Distribution of the cost of central services (excluding those at the Bouaké centre) by sector

	Direct costs (in millions of C.F.A. francs)	Percentage of total direct costs	Share of central service costs
Reception	952	42.4	50
Written materials	480	21.4	25
Training	273	12.2	14
Production	538	24.0	28
TOTAL	2,243	100.0	118

1. The cost of accommodation for foreign technical assistants is estimated at 1 million C.F.A. francs per person per year.

When the costs of joint services and central services are added to direct production costs, the result is as follows: direct costs—529 million 1975 C.F.A. francs, joint services costs—92 million, central services costs—28 million, making a total for operating costs of the Production Division in 1975 of 649 million.

Production costs: investments

Between 1969 and 1973, the temporary premises loaned to the centre were altered and equipped with electronic apparatus. The relevant accounts usually enable the costs incumbent on production, training and written materials respectively to be distinguished.

We have therefore identified all the transactions during this period and then converted the figures into 1975 C.F.A. francs.

The new centre was built during 1975 and 1976 and it is difficult to ascribe the expenditure involved to each division. It is, in fact, impossible to proceed on the basis of operating costs since the written materials division now has premises outside the new centre.

Investment costs ascribed to written materials, therefore, are limited to their *pro rata* contribution to the accommodation of the joint services and general administration and to that of the pedagogical staff.

In examining cost per student, the document dated 19 March 1976 issued by the Service Autonome and the Direction des Études de Développement appears to ascribe 50 per cent of expenditure on the new centre to 'production'. We shall employ the same figure, which seems very reasonable, and divide the remaining 50 per cent between 'training' (40 per cent) and 'written materials' (10 per cent).

We shall regard the new studios as being for production alone, on the assumption that the Training Division will transfer their present equipment.

Where the new studios are concerned, the Club d'Abidjan, at its meeting in March 1976, decided to equip two only, one in 1977 and the other in 1978. The choice between 'colour' and 'black and white' has not yet been settled. Preliminary contacts with the industry suggest a substantial difference in cost: 80 million C.F.A. francs for a 'black and white' studio as against 600 million for a 'colour' studio.

As we have not chosen colour television sets for the schools, we opt for black and white studios. This technical argument is backed up by an economic one: 'the annual cost of immobilized capital on a studio for colour is roughly equal to the cost of purchasing a black-and-white studio. In other words, black-and-white television makes it possible to change over to colour at any time without incurring any additional expenditure'.

Supporters of the colour option can argue that, in the medium term, colour is inevitable and that the black-and-white studios will be obsolete before amortization. But at whatever future date black-and-white equipment is abandoned its residual value will be less than the annual depreciation of a colour studio.

TABLE 17. Investment costs for the Television Production Division (in millions of 1975 C.F.A. francs)

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Equipment and alterations of former television production centre	492	107	178	13	68	—	—	—	—	—
Total cost of a new centre	—	—	—	—	—	—	800	930	70	—
Share ascribed to television production										
Buildings (50%)	—	—	—	—	—	—	400	465	35	—
Studio	—	—	—	—	—	—	—	—	80–600	80–600
Total investments for television production	492	107	178	13	68	—	400	465	115–635	80–600

Broadcasting

The programmes produced at Bouaké are broadcast by the Radio-Télévision Ivoirienne network. A small team, based at Bouaké under the Sub-Directorate for Production, transmits these programmes to the RTI at Abidjan via the Bouaké–Abidjan radio link.

In 1975, the RTI received 78 million C.F.A. francs in fees for use of their network. In a document submitted to DOGE on 16 November 1976, RTI announced its desire to raise this contribution to 162 million C.F.A. francs, broken down as follows: staff, 73.7 million; network maintenance (50 per cent), 58.5 million; fuel, 30.0 million; or a total of 162.2 million C.F.A. francs.

This figure is arrived at by apportioning a rough average cost between RTI and educational television. However, in terms of marginal cost, almost all the expense of servicing the network disappears. In terms of staff, there would remain a day caretaker for transmitters and relay stations—about 26,000 hours of work at 450 C.F.A. francs an hour, giving 11.7 million C.F.A. francs. Lastly, fuel is billed at its full price—inclusive of all taxes—whereas in the Ivory Coast budget,

TABLE 18. Number of hours of broadcasting

	1971/72	1972/73	1973/74	1974/75
CP 1	119.0	90.5	94.6	95.0
CP 2	—	95.0	87.4	86.0
CE 1	—	—	80.0	73.0
CE 2	—	—	—	58.0
Training and re-training of teachers	73.0	112.0	86.0	85.0
TOTAL	192.0	297.5	340.7	397.0

these taxes are an internal operation, not a cost. We therefore estimate the real cost of fuel at 15 million C.F.A. francs. The marginal cost incumbent on educational television can thus be estimated at $73.7 + 15 - 11.7 = 77$ million C.F.A. francs, which is nearly equivalent to present payments. The number of hours of broadcasting are as shown in Table 18.

In 1975, when fees of 78 million C.F.A. francs were paid to RTI, the cost per hour of broadcasting was 196,400 C.F.A. francs.

Other costs of the reform: training, re-training and written materials

Training and re-training of teachers

Most cost studies of educational television in the Ivory Coast include expenditure on the training and re-training of schoolteachers at the Bouaké centre but usually exclude expenditure on training at the other CAFOP centres. This raises an important question of method which needs to be discussed.

There are two possible approaches: (a) to seek to isolate the specific costs of the PETV in relation to a traditional education system, and (b) to cost the various elements of the Ivory Coast's system of primary education without attempting to compare them with what they would be without television.

Both approaches are of interest but, if the results and experience of the Ivory Coast experiment are to be of use to other countries, it is important to know the additional costs that the experiment entails. Similarly, if it is desired to compare the educational performance of the system with that of traditional methods, the specific costs of using television have to be isolated. In other words, we must try to work out the additional costs (or possible savings) of training schoolteachers through television, rather than in the ordinary way.

This task is made even more difficult and arbitrary by the fact that, before PETV was introduced, teacher training was extremely short and would have had to be improved in any case. It is possible, however, to advance the following hypotheses:

Without PETV, teacher training would have lasted at least as long as it does now, since one of the PETV objectives was precisely to solve the problem of inadequately qualified teachers by giving them a powerful teaching aid, television.

Hence, the costs incurred for lecture rooms, instructors, lodgings, food and scholarships would have been at least as high.

The items which would probably not have existed in the traditional system are: purchase of television sets for CAFOP classes; production and broadcasting of programmes for the training or re-training schoolteachers; and use of school television sets for the training or re-training of teachers.

However, most of these items have already been covered under the various cost headings already examined: reception, production and broadcasting.

The only things not yet accounted for are a closed-circuit television and studio installed at the Bouaké centre for teacher-training purposes exclusively, and the training of staff in audio-visual techniques.

In our view, the closed-circuit television is not a consequence of PETV but springs from more general educational considerations which militate in favour of employing this kind of facility even in education systems not based on television.

The training of audio-visual specialists, for its part, is difficult to cost separately and it will be included with the other training costs, of which it forms a very small part.

The costs we are about to analyse are not, therefore, to be ascribed to television. They are the costs of a sub-sector of the Ivory Coast's primary education system or of one of the elements in the *renewal* of its education system.

TABLE 19. Teacher training: 1975 operating costs (in millions of 1975 C.F.A. francs)

Section III of the ENS[1]	Ivory Coast personnel	6
	Technical assistants	16
	Accommodation for technical assistants	4
	Equipment and casual workers	1
	Student allowances	37
	Sub-total ENS	64
Bouaké	Ivory Coast personnel	30
	Technical assistants	136
	Accommodation for technical assistants	37
	Equipment and casual workers	61
	Scholarships	9
	(Sub-total direct costs)	(273)
	Share of joint services	46
	Share of central services	14
	Sub-total Bouaké	333
Other CAFOP centres	Ivory Coast personnel	103
	Technical assistants	247
	Accommodation for technical assistants	68
	Equipment and casual workers	163
	Scholarships	21
	Sub-total other CAFOPs	602
TOTAL		999

1. École Normale Supérieure (College of Education): this section is particularly concerned with training primary-education inspectors.

TABLE 20. Teacher training: investments (in millions of 1975 C.F.A. francs)

		1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Total
Bouaké centre	Old centre[1]	186.4	28.8	46.3	2.6	—	0.7	—	—	—	—	—	—	—	262.2
	New centre (40 per cent)	—	—	—	—	—	—	320	372	28	—	—	—	—	720
	Total	186.4	28.8	46.3	2.6	—	0.7	320	372	28	—	—	—	—	982.2
Other CAFOP centres	Buildings	—	—	—	—	—	462[2]	—	924[3]	462[4]	—	462[5]	—	462[5]	2,272
	Audio-visual equipment	—	—	—	—	—	35	—	70	35	—	35	—	35	210
	Other equipment	—	—	—	—	—	70	—	140	70	—	70	—	70	420
	Total	—	—	—	—	—	567	—	1,134	567	—	567	—	567	3,402
TOTAL		186.4	28.8	46.3	2.6	—	567.7	320	1,506	595	—	567	—	567	4,384.2

1. Including 14.2 per cent of joint services costs.
2. Man CAFOP.
3. The Abengourou and Gagnoa CAFOPs.
4. The Yamoussoukro CAFOP.
5. Location not yet determined.

Written materials

Just as many PETV cost studies include teacher training at Bouaké, a certain number regard the written materials as a necessary consequence of PETV, a kind of vital complement to the medium of television. This is not true. It would have been quite possible to plan the use of television without printing special documents to go with it. Moreover, the converse also holds because these printed documents have been distributed to certain classes not in the television scheme, thus implying that although television and the written materials are integrated as regards subject-matter and progression, their use together does not suggest a technology whose inputs are inseparable, like coke and iron ore in the production of cast iron.

We shall regard the written materials as an independent medium which, like television, is part of the reform of the primary education system in the Ivory Coast, and treat operating and investment costs accordingly.

TABLE 21. Cost of documentary support (in millions of 1975 C.F.A. francs)

Investments		
Construction of buildings	100	
Proportion attributable to new centre (10 per cent)	180	
1975 value of material and equipment delivered 1973–75	390	
Other equipment	20	
TOTAL INVESTMENTS		690
Operating costs (1975)		
Ivory Coast personnel	18	
Technical assistants	228	
Accommodation for technical assistants	26	
Materials: paper	124	
cardboard	31	
others	23	
Electricity	3	
Other materials and casual workers	27	
SUB-TOTAL: direct expenditure	480	
Share of joint services costs	82	
Share of central services costs	25	
TOTAL		587

It will be noted that the sub-directorate for written materials costs almost as much as the sub-directorate for television production. It probably appears less expensive to the Ivory Coast authorities as it is largely financed by external long-term loans at a low rate of interest. But the fact remains that it is a very heavy burden.

There are two reasons for such high costs:

There is a large proportion of technical assistants who, furthermore, being Canadian and thus not Ivory Coast civil servants, are highly

paid. When Ivory Coast nationals take over this division, staff costs should fall considerably.

The documents distributed to pupils are reprinted every year, even if the content is in no way changed, thus entailing a very heavy consumption of paper.

This point has prompted discussion about the advisability of prolonging the average life of printed documents to two or even three years.

According to DOGE calculations, the cost of paper and cardboard (not including transport and taxes) will, in the next few years, follow the pattern shown in Table 22.

TABLE 22. Evolution of expenditure on paper and cardboard (in millions of C.F.A. francs)

Year	Paper	Cardboard	Total	Annual increase (%)
1976/77	121	40	161	—
1977/78	173	52	225	+40
1978/79	249	64	313	+39
1979/80	324	81	405	+29
1980/81	412	101	513	+27

TABLE 23. General recapitulation of the costs of television for primary education (excluding classrooms) (in millions of 1975 C.F.A. francs)

		1971	1972	1973	1974	1975	1976	1977	1978
Costs related to television	Reception	434	622	814	854	879	977	1,132	1,6[illegible]
	Production: Operating costs[6]	240	311	506	552	649	649	649	64[illegible]
	Production: Investments	777[1]	13	68	—	400	465	115	[illegible]
	Broadcasting	78	78	78	78	78	78	78	[illegible]
	Total	1,529	1,024	1,466	1,484	2,006	2,169	1,974	2,49[illegible]
Costs related to written materials	Operating costs	217	282	458	499	587	587	587	5[illegible]
	Investments	100	—	140[4]	140[4]	220[4]	90	—	—
	Paper[7]	—	—	—	—	—	161	165	[illegible]
	Total	317	282	598	639	807	838	752	7[illegible]
Costs related to training	Operating costs[6]	370	480	780	850	999	1,290[8]	1,290	1,8[illegible]
	Investments	261[1]	3	—	568	320	1,506	595	—
	Total	631	483	780	1,418	1,319	2,796	1,885	1,8[illegible]
Total other operating costs[9]		563[10]	1,484[10]	2,745[10]	4,117[10]	5,909[10]	10,848	14,690	18,0[illegible]
TOTAL		3,040	3,273	5,589	7,658	10,041[11]	16,651	19,301	24,1[illegible]
Pupil numbers in thousands		22	58	107	161	231	327	429	5[illegible]

1. Sum of 1969, 1970 and 1971 investments.
2. For 1981 onwards, the cost of accommodation for foreign technical assistants has been omitted.
3. Renewal for 'black and white' television studios.
4. Printing equipment; cost spread arbitrarily over three years.
5. Renewal of printing equipment.
6. From 1971 to 1974 Bouaké operating costs are estimated globally, in proportion to number of persons employed in each division, as a percentage of the figure for 1975: 85 per cent in 1974, 78 per cent in 1973, 48 per cent in 1972, and 37 per cent in 1971.

These forecasts imply almost intolerable increases in expenditure since costs will triple in five years. They assume, it is true, that prices will rise by 10 per cent a year, which is perhaps more than a simple increase in costs although there have been, in recent years, big increases in the cost of paper on the world market.

One obvious way of slowing down the rise in costs is to prolong the average life-span of printed documents by designing them so that they can be re-used. No country in the world, not even among the most developed, has ever followed a system which called for printed documents to be systematically renewed each year.

In our view, a two-year life-span should make it possible to stabilize the manpower requirements of the sub-directorate concerned at their 1975 level.

In 1976/77 the foregoing suggestion could be put into effect: there could be a general distribution together with enough extra copies for the 90,000 additional pupils (+28 per cent) in the same classes the following year. This would cost 161 million multiplied by 1.28 = 206 million C.F.A. francs.

In 1977/78, as the same documents would be used by the next year-groups, it would be possible to organize the new rhythm of production

1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1,662	2,366	2,119	1,310	1,386	1,445	1,613	1,738	1,852	1,758	1,726	1,945
649	649	587[2]	587	587	587	587	587	587	587	587	587
—	—	—	—	—	—	—	—	80[3]	80[3]	—	—
78	78	78	78	78	78	78	78	78	78	78	78
2,389	3,093	2,784	1,875	2,051	2,110	2,278	2,403	2,597	2,503	2,391	2,610
587	587	561	561	561	561	561	561	561	561	561	561
—	—	—	—	140[5]	140[5]	130[5]	—	—	—	—	—
238	274	308	337	366	395	426	457	488	518	546	573
825	861	869	898	1,067	1,096	1,117	1,018	1,049	1,079	1,106	1,134
2,154	2,154	2,442	2,442	2,730	2,730	2,730	2,730	2,730	2,730	2,730	2,730
567	—	567	—	—	—	—	—	—	—	—	—
2,721	2,154	3,009	2,442	2,730	2,730	2,730	2,730	2,730	2,730	2,730	2,730
23,093	27,484	32,031	36,288	40,921	45,700	51,051	56,729	62,782	68,873	75,036	80,462
29 028	33,592	38,693	41,603	46,769	51,636	57,176	62,880	69,158	75,185	81,263	86,936
619	712	800	876	951	1,025	1,106	1,187	1,268	1,345	1,418	1,487

7. From 1977 onwards, estimated on the basis of half the 1975 cost per pupil (770 C.F.A. francs). For previous years the cost of paper is included in the overall operating costs.
8. In 1976, the operating costs of training about 1,000 schoolteachers came to 999 million C.F.A. francs; i.e. 1 million C.F.A. francs per trained teacher. This figure has been employed for subsequent years and the intake capacity of the CAFOP centres taken into account.
9. Projedor 9, page 13, based on the number of television pupils in all primary education.
10. Unit cost in 1975 (from document of 19 March 1976) multiplied by number of television pupils.
11. + 1,249: impact of leaving the established salary scale (1976 decision to raise considerably the salaries of teachers in relation to other civil servants).

to cover the needs of the next two years (1978/79 and 1979/80), but for only half the classes (or half the subjects), the other half being produced in 1978/79.

What reductions in cost can be expected from this system?

If, as we believe, it is possible to meet requirements with the present staff, the only variable costs are those for paper, cardboard and various printing supplies. With the present system, these variable costs would, in 1980, exceed fixed costs if the latter remain stable, whereas they come to only one-quarter of fixed costs today. Moreover, if, as is planned, the staff includes all Ivory Coast nationals by 1980, fixed costs will fall by a good third, making variable costs a third higher than fixed costs. By doubling the life-span of printed materials the variable costs are cut by half and decrease to about two-thirds of the fixed costs, themselves lower because the staff is now composed of nationals only.

In short, this measure reduces the estimated costs in 1980 by a good 25 per cent. We shall return in Part 2 to a systematic study of the impact of each possibility on costs.

Part 2. Cost functions, comparisons and outlook

Cost functions

PETV occasions certain *fixed* costs, i.e. not dependent on the number of pupils, while others are *variable* because they reflect pupil numbers. If F represents fixed costs, V the variable cost per pupil and N the number of pupils, the function of total cost (TC) is

$$TC = F + VN$$

From this we derive the function of average cost $\frac{TC}{N}$ by dividing the above equation by the number of pupils (N):

$$\frac{TC}{N} = \frac{F}{N} + V$$

Where PETV is concerned, the fixed costs cover the production of television programmes, the production (but not printing) of written materials and broadcasting; the variable costs relate to reception, the printing of written documentary materials and the running of the classes (teachers and classrooms).

Though fixed costs are relatively easy to arrive at, variable costs are quite another matter since, in this case, they are not linear; that is, they do not remain constant in time. It has been shown, for example, how the cost of supplying the television receivers with electricity falls sharply

TABLE 24. *Variable costs per pupil (in 1975 C.F.A. francs)*

1975	*Television*	*Operating costs (maintenance, power supply)*	3,062			
		Investments	Purchase price	Annual repayment at 0 per cent	Annual repayment at 7.5 per cent	Annual repayment at 15 per cent
		Receivers and accessories (seven years)	3,376	483	638	810
		Masts, aerials, battery containers (ten years)	1,446	145	211	288
		Test equipment and vehicles (five years)	458	92	113	136
		TOTAL		3,782	4,024	4,296
	Written materials	Operating costs	2,134			
	Teacher training		777[1]			
	Other operating costs		25,580			
	TOTAL			32,273	32,515	32,787
1985	Television	Operating costs	770			
		Investments	Purchase price	Annual repayment at 0 per cent	Annual repayment at 7.5 per cent	Annual repayment at 15 per cent
		Receivers and accessories	3,376	483	638	810
		Masts and aerials	1,446	145	211	288
		Test equipment and vehicles	458	92	113	136
		TOTAL		1,490	1,732	2,004
	Written materials	Operating costs	892			
	Teacher training		777[1]			
	Other operating costs		46,158			
	TOTAL			49,317	49,559	49,831

1. Unit cost from document dated 19 March 1976.

over the years whereas the cost of schoolteachers will tend to rise slightly because of progressively smaller average classes.

In Table 24 we have estimated variable cost factors by expressing investment expenditure as annual instalments at three alternative levels, depending on the bank rate.

The use of a bank rate can be defended here on the grounds that, were the expenditure financed through a loan, the annual repayments would include interest on the capital borrowed. But since, for one thing, part of the equipment was given to the Ivory Coast, thus obviating the need to finance it, and for another, there exists no objective market rate to refer to, we have employed the rates proposed in previous studies.

We have also used the same alternative rates to calculate the fixed investment costs in relation to the number of pupils (Table 25).

The function of total cost in 1975 (assuming a bank rate of 7.5 per cent) is, therefore,

$$TC = 1{,}109{,}000 + 32{,}515\,N$$

from which the average cost per pupil may be derived:

$$\frac{TC}{N} = \frac{1{,}109{,}000}{N} + 32{,}515.$$

TABLE 25. Total fixed costs per year
(in millions of 1975 C.F.A. francs)

Operating costs	Television production[1]	649			
	Production of written materials[2]	94			
	Broadcasting	78			
	TOTAL OPERATING COSTS	821			
		Total cost	Annual repayment at 0 per cent	Annual repayment at 7.5 per cent	Annual repayment at 15 per cent
Investments	*Television production*				
	Buildings (fifty years)	900	18	69	135
	Equipment (ten years)[3]	938	94	137	187
	Production of written materials				
	Buildings (fifty years)	280	6	22	42
	Equipment (ten years)	410	41	60	82
	TOTAL FIXED COSTS PER YEAR		980	1,109	1,267

1. See page 130.
2. Calculated pro rata on the basis of the number of persons employed in the preparation and reproduction of written materials, namely 23 per cent, the total operating costs being those in Table 23 less cost of paper, cardboard and other supplies, which are really variable costs.
3. With only one new 'black and white' studio at new centre.

Similarly, total cost in 1985 will be

$$TC = 1{,}109{,}000 + 49{,}559\,N$$

and average cost per pupil

$$\frac{TC}{N} = \frac{1{,}109{,}000}{N} + 49{,}559.$$

The curve of average costs per pupil in Figure 2 is particularly interesting because it clearly displays two phenomena:

Average costs fall sharply until the number of pupils reaches 200,000–300,000. Beyond this threshold fixed costs are negligible; in other words, the Ivory Coast's experiment in education by television is, in 1976, on a large enough scale to justify incurring the extra fixed costs arising from the use of television;

In 1985, the average cost per pupil will be quite a lot higher than in 1975 because variable costs will have increased substantially. But when the structure of these variable costs is examined (Table 24), it emerges that between 1975 and 1985 the proportion relating to television and written materials will have dropped considerably whereas basic factors such as the remuneration of teachers (as a result of

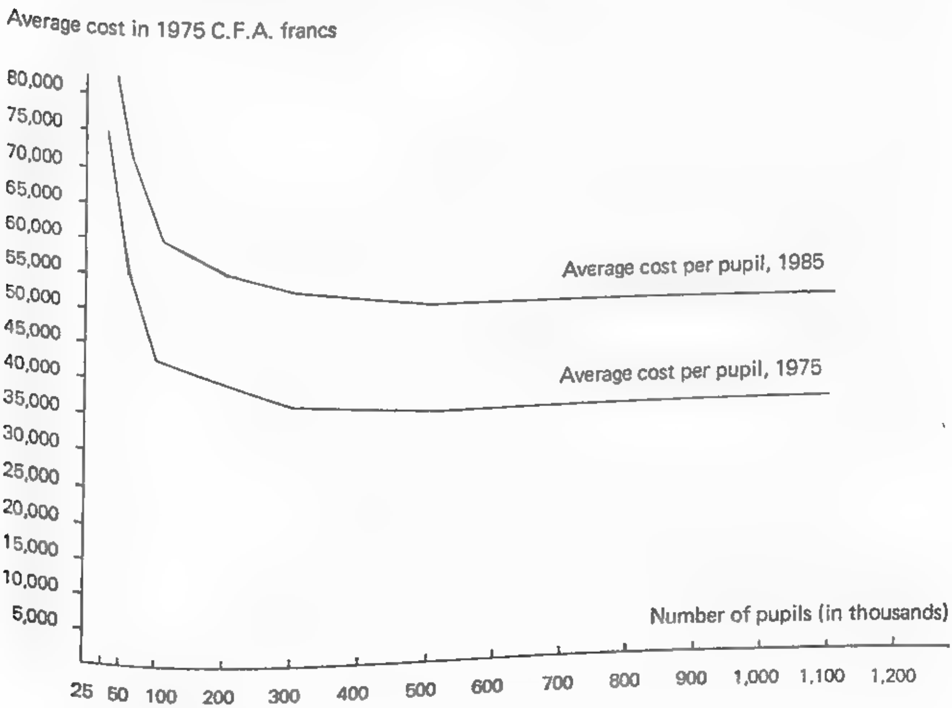

FIG. 2. Average costs per pupil.

upgrading in 1976[1]) and classroom overheads will have greatly increased in cost. For example, the cost of television, 12.4 per cent of total variable costs per pupil in 1975, will have fallen to an almost insignificant 3.5 per cent in 1985.

It may be concluded that in 1976 PETV reached a level of development at which the costs associated with television are perfectly reasonable and that, in 1985, when the system will be expanding, the country will regard the television issue as much less important than teachers' salaries. In 1985, whether a traditional system of education is more or less expensive than one based on the media will no longer be the issue. Debate will focus, for example, on how a developing country is to finance 100 per cent enrolment of its future generations, or on the salary scale of teachers in relation to other social categories.

The financing of PETV

PETV was launched with the help of many external sources of aid, including Unesco, the Coopération Française (Fonds d'Aide à la Coopération (FAC)), the United Nations Children's Fund (Unicef), and Canada. An International Bank for Reconstruction and Development (IBRD) loan made it possible to finance the building of the new Bouaké centre.

This assistance is specific, each partner supporting a particular sector of PETV. Unesco has contributed highly skilled manpower and audio-visual equipment; Canada has financed the investments for the written materials printing works and about thirty technical assistants to run it; Unicef has contributed mainly to the training and re-training of school-teachers, and FAC has covered part of the cost of French technical assistance and half the cost of investments in audio-visual equipment (e.g. purchase of television sets).

This assistance is meant to be of limited duration. The fact is that technical assistance with staffing, which accounts for the greater part of operating costs financed by foreign aid, is diminishing as Ivory Coast nationals take over, a process that is theoretically due to be completed by 1980 though it is still difficult to say whether this timetable can be respected.

Table 26 sets out the proportion of overall costs borne by foreign aid from the start of the project up to 1975. Figures for subsequent years are not given, it being understood that from 1976 foreign aid will gradually diminish and reach zero in the 1980s.

Foreign aid was particularly substantial at the start of the project, accounting for 60 per cent of initial costs. It will be seen that it has diminished quite quickly, since it stood at only 16 per cent in 1975.

1. See Table 23, footnote 11.

TABLE 26. The financing of PETV (in millions of 1975 C.F.A. francs)

	1969/70/71		1972		1973		1974		1975	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Unesco	523	17.2	251	7.7	211	3.8	148	1.9	162	1.4
FAC	1,165	38.3	802	24.5	843	15.1	763	10.0	700	6.2
Unicef	137	4.5	69	2.1	50	0.9	26	0.3	—	
IBRD	—	—	—	—	—	—	—	—	332	2.9
Canada	—	—	65	2.0	479	8.6	726	9.5	622	5.5
Ivory Coast[1]	1,215	40.0	2,006	63.7	4,006	71.7	5,995	78.3	9,473	83.9
TOTAL	3,040	100.0	3,273	100.0	5,589	100.0	7,658	100.0	11,290	100.0

1. The Ivory Coast figures include the payment of PETV teachers but not the depreciation of classrooms.

Source: DOGE and previous tables (25 November 1976).

When the new centre is finished in 1977, it will probably fall to about 10 per cent and gradually stop altogether in the 1980s.

It should be added that specific assistance for project evaluation has been provided by Belgium, the United States of America and the Federal Republic of Germany.

Resource allocation for education in the Ivory Coast

Proportion of national budget spent on education

The Ivory Coast has made a great effort to develop education, but the amount spent on PETV forms a relatively modest proportion of the total. The 1975 figures for all expenditure by the Ministry of National Education show that PETV accounts for only 26.3 per cent since the ministry also finances traditional primary education, secondary and higher education as well as subsidizing the private sector.

Table 27 shows that when foreign aid, which passes via the Ministry of Finance to pay foreign teachers, is added to PETV expenditure, the State devoted 35.2 per cent of its 1971 budget to education, and that this proportion is now reaching 40 per cent. These figures do not include expenditure on education by other ministries, such as the Ministry of Technical and Vocational Education which spends 3,000–4,000 million C.F.A. francs, representing an extra 3–4 per cent. Few countries are making such an effort for education; in France, for example, the equivalent proportion is about 17 per cent.

Proportion of gross domestic product (GDP) spent on education
Families sending their children to private schools pay fees. When these are added to the previous total, the total national resources devoted to education represents about 7 per cent of GDP.

It should nevertheless be noted that this figure does not include expenditure on technical education (4,000 million C.F.A. francs) or on school-building by local communes (2,000 classrooms a year at 3 million each: 6,000 million C.F.A. francs).

With these additional 10,000 million C.F.A. francs—1.2 per cent of GDP in 1975—the total allocation for education reaches between 8 and 9 per cent of national resources and places the Ivory Coast alongside the Scandinavian countries as a world leader in this respect.

Future outlook
Planned growth in expenditure up to 1990. Table 23 shows that, in 1990, expenditure on PETV will be eight times the 1975 figure. Calculations by the Service Autonome d'Étude et de Gestion des Programmes Scolaires (SAEGPS) and the Planning Department, in conjunction with DOGE, indicate that if access to the first year of secondary education is maintained at the same level as previous years, expenditure on secondary education will also increase eightfold. These two sectors absorb about 55 per cent of total expenditure on education. If we posit as a minimum a fourfold increase in expenditure on upper secondary, technical and vocational and higher education, disregarding the possible development of the non-formal sector, expenditure on education (1975 = 100) will

TABLE 27. Allocation of resources to education (in millions of C.F.A. francs)

	1971	1972	1973	1974	1975
Ministry of Education operating costs	19,412	22,733	27,480	35,227	42,927[1]
Foreign aid	3,673	3,856	4,084	4,683	5,034
Total	23,085	26,589	31,564	39,910	47,961
Regular Budget of the State	65,700	72,777	86,590	106,732	120,988
Percentage of Ministry of Education	35.2	36.5	36.5	37.4	39.6
Private expenditure on education	808	916	1,082	1,359	1,673
Investments	5,965	6,605	7,311	8,591	15,330
Total expenditure on education	29,859	34,111	39,957	49,854	64,960
Gross domestic product (GDP)	440,000	472,000	565,000	739,000	814,000
Percentage of GDP	6.8	7.2	7.1	6.7	8.0

1. 41,673 without upgrading.

grow as follows: primary and lower secondary education for 1975 is 55 and for 1990, 440 while other levels of education equal 45 for 1975 and 180 for 1990, totalling 100 for 1975 and 620 for 1990.

Under present conditions, expenditure on education in real terms will be multiplied by more than 6 in the fifteen years from 1975 to 1990.

If, during the same period, GDP doubles in real terms, this means that the Ivory Coast will be spending three times more in proportion than today, or over 20 per cent of its GDP. If GDP is multiplied by 3, a very optimistic hypothesis, the Ivory Coast will still spend 15 per cent of its GDP on education in 1990.

At present there exists no objective technique making it possible to call this allocation of resources irrational or impossible. It should be observed, however, that countries spending more than 5 per cent of GDP on education—usually developed countries—increased such expenditure sharply during the 1960s but, since about 1970, have manifested a general tendency towards stabilization. This makes it rather unlikely that other countries apart from the Ivory Coast are getting ready to exceed the 10 per cent threshold in the next few years.

If it is assumed that, for various reasons, the Ivory Coast is unable to surpass 10 per cent yet at the same time cannot resist the social pressures for maintaining the present access rate to secondary education and keeping the same growth rate in primary education, the only possible solution would be to allow inflation to develop at a higher rate than the nominal increases in teachers' salaries, which account for over 80 per cent of education costs.

Assuming that GDP doubles in real terms, the general situation would be as follows: GDP for 1975 is 813,000 million C.F.A. francs while for 1990 it is 1,626,000 million; education for 1975 is 63,000 million while for 1990 it is 390,000 million, making a percentage for 1975 of 7.7 and for 1990, 24.0.

If these 390,000 million C.F.A. francs are to represent only 10 per cent of GDP, the face value of GDP must be 3,900,000 million francs, or 2.4 times its real value; this corresponds to a 140 per cent inflation rate over the period as a whole, or about 6 per cent per year. In other words, the present equilibrium can only be maintained if the annual inflation occasioned by the development of education alone is 6 per cent and if teachers receive no salary increases at all during the period, which would mean that their real income would drop by 60 per cent.

If, for example, teachers manage to obtain nominal increases of 5 per cent, the inflation rate due to the development of education would rise from 6 to 11 per cent. As the present rate of inflation probably lies between 5 and 10 per cent, the rate to be anticipated would work out at between 16 and 21 per cent, which is probably too high to maintain the present exchange value of the C.F.A. franc over a long period. Thus, interest in the development of education is a considerable threat to the value of the C.F.A. franc.

The impact of 'upgrading'

'Upgrading' came about as the result of a governmental decision to grant teachers alone among government employees a substantial increase in salary (40 per cent). As at least 80 per cent of expenditure on education is used to pay teachers, total expenditure in 1990 (390,000 million C.F.A. francs) would include 312,000 million for salaries, of which 40 per cent (125,000 million) is due to upgrading. This represents 7.7. per cent of the real GDP (1,626,000 million). In other words, half the additional expenditure on education over the next fifteen years, which will triple in relative terms, may be put down to the decision to 'upgrade' teachers and the other half to the expansion of the system itself. Without 'upgrading', the 10 per cent limit would have been exceeded by very little and an annual inflation rate of 2 per cent would have been enough to cover the expansion of the system.

Comparisons with the Klees-Jamison study

The Klees-Jamison study (1973 and 1976) deals with the same period of time (1970–90) but results in different overall and unit costs, for two essential reasons:—the projected number of enrolments, then 1,100,000 pupils, has now been increased by 400,000;—'upgrading' has increased real salaries substantially so that 1975 costs are about 40 per cent higher.

Moreover, the Klees-Jamison study only examined the costs of television programmes and written materials, disregarding the cost of training and paying teachers.

On the first two points, the two studies differ as follows (in millions of C.F.A. francs: 1972 francs for Klees-Jamison, 1975 francs for Eicher-Orivel):

1975		1990	
Klees-Jamison	Eicher-Orivel	Klees-Jamison	Eicher-Orivel
2,518	2,813	3,313	3,744

This is not a big difference, especially when allowance is made for the fact that Klees and Jamison were working in 1972 francs.

The explanation is that certain factors cancel each other out: Klees and Jamison underestimate teacher salaries and pupil numbers but this is counterbalanced by overestimated reception costs owing to the continued use of alkaline batteries. In their study, the cost of batteries actually comes to 41 per cent of total costs in 1990 whereas that of the solar cells advocated in this report represents less than 1 per cent. The cost structure is therefore fundamentally different and the similarity of overall results is mainly coincidental.

In regard to average costs for the television programmes alone, Klees and Jamison arrive at 3,882 1972 C.F.A. francs for the period 1969–90 as against our 3,713 1975 C.F.A. francs. This odd similarity is again because different factors cancel each other out.

General conclusion and recommendations

Klees and Jamison came to the conclusion that the costs per pupil of producing television programmes were, in the Ivory Coast, somewhat higher than those of comparable experiments in other countries. This is mainly put down to the problem of supplying television sets with electricity. Our view is that progress in solar-cell technology is gradually outdating this diagnosis, and yet the unit costs in our study are not significantly lower. In our opinion this is for the following reasons:

The output capacity for television programmes and written materials has been allowed to expand too quickly with the result that production is at present far—though it is difficult to state exactly how far—below the potential level, thus entailing high fixed costs.

A salary structure incompatible with the country's true capacities has been allowed to develop within the education system. The annual salary of a young teacher is over $5,000 whereas the per capita GDP is only $500, or a mere tenth of this. In France, for example, a teacher costs about the same at the start of his career but the per capita GDP is also about $5,000, giving a ratio of 1 : 1 as against 10 : 1.

This salary structure affects the cost of the educational television programme but its major impact is on the cost of classroom teachers.

In other words, while not denying the Klees-Jamison contention that the Ivory Coast educational television scheme is rather expensive in absolute terms, we should like to take a more balanced view of the cost by stressing that it is a *marginal* factor in the overall cost of primary education. To illustrate this point, it should be recalled that a slight improvement in the teacher/pupil ratio during the period under review, from 44 to 41.5 pupils per class would increase the cost per pupil by 5.7 per cent, or by about the same as the medium of television itself (production and broadcasting).

General recommendations

Supply of electricity for the television receivers
The cost of using alkaline batteries will soon be prohibitive; though we have been cautious in assessing the future of solar cells, our calculations suggest that, in 1990, their cost will be one-hundredth of its present level. Careful attention should therefore be paid to the development of solar technology

so that the change-over can be made as soon as possible. In addition, schools should be connected to the mains whenever possible (DOGE has noted irritating delays in this respect).

Rate of expansion of the system

The change-over from one source of power to another will take place at the beginning of the 1980s and put extra strain on the budget. We suggest that if enrolment objectives remain unchanged, fewer new classes should be started in 1979, 1980 and 1981 (1,500 instead of 2,120) and the lost ground made up in 1982, 1983 and 1984.

Number of television sets per class

The decision to equip each classroom with a television set was discussed by Klees and Jamison and by the Architectural Unit of the Ministry of Education, who both recommend one set for two classes. According to the Architectural Unit, the sound-proof housing within which the single television set for two adjacent classes would pivot would increase building costs by about 25,000 C.F.A. francs, or a quarter of the price of at television receiver. In other words, this solution would reduce expenditure on sets by three-eighths or 37.5 per cent and save 136 million C.F.A. francs in 1980 (4.4 per cent of all television costs or 0.4 per cent of the total cost of primary education by television) and 218 million C.F.A. francs in 1990 (8.3 per cent of all television costs and 0.25 per cent of total primary education by television costs). This saving should be set against a few minor disadvantages—breakdowns disturbing twice as many people, class time lost through frequent swivelling of the television—and allow for the fact that many people regard the estimated cost of 25,000 C.F.A. francs as both optimistic and bound to increase in relation to the cost of a new television set.

We recommend this solution so long as the additional classroom construction costs remain substantially lower than the purchase price of a television set.

Electronic equipment for the new studios

Without taking sides on whether or not educational television should change over to colour, we feel that a decision on this matter is rather unlikely in the next ten years. Since this is approximately the life of a studio we recommend continuing with 'black and white' equipment at the Bouaké production centre.

Optimal use of production

The most optimistic analyses state that only 40 per cent of the production capacity for television programmes and documentary support is being used. We therefore recommend that all non-formal and other educational needs at various levels should be covered by the Bouaké centre so that the Ivory Coast will not find itself generally over-equipped.

Pupil/teacher ratio

No serious educational evaluation has yet shown any qualitative difference between pupils in classes of 44 and those in classes of 42.[1]

On the other hand, it is well known that smaller classes ease the task of teachers. Now that primary teachers are relatively well placed in comparison with other social categories, it appears difficult to justify a further improvement of their living conditions. We therefore recommend holding the staffing ratio at its present level (44), thus enabling a sum equal to the cost of the television medium to be economized.

Written materials

The cost per pupil of written materials seems high. This is because of the policy of annual replacement, the quantity of documents involved, the cost of immobilized capital and the upward trend in the price of paper. There are several possible complementary or alternative solutions: use of the printing works for other purposes; reduction in the number of workbooks by transforming them into textbooks; a longer life for printed documents.

Our estimates assume that the cost of paper per pupil would be halved, thus reducing by a quarter the variable costs of written materials.

Broadcasting

The RTI network is made available to educational television for six-and-a-half hours a day for the 200 days of the school year, that is, 1,300 hours per year. In 1975/76 school television broadcasts totalled about 400 hours and, with the CM 2 classes functioning normally, are unlikely to exceed 500. In theory, then, 800 hours set aside for educational television are not used could thus be possibly employed for other levels. We stress this point since the unused production capacity, whether for television programmes, written materials or broadcasting, would make it possible to provide other services whose marginal cost would be nil.

A second problem to do with broadcasting is whether our approach, in terms of marginal cost rather than average cost, is legitimate. We have reasoned that the network would exist even without educational television, though it may be objected that country-wide television coverage would have taken longer and that the hours set aside for school broadcasts restrict the freedom to broadcast for commercial ends. An even more serious objection is that our evaluation of the Ivory Coast experiment cannot be compared with evaluations conducted in other countries with no pre-existing and available television network.

Our position, however, may be explained by emphasizing two points. First, it was not possible to reconstitute the cost of equipping the

1. See the surveys of the International Evaluation Association, especially A. Harry Passow, Harold J. Noah, Max A. Eckstein and John R. Mallea, *An Empirical Comparative Study of 21 Educational Systems*, Stockholm, Almqvist & Wicksell.

network. The invoice presented to educational television by RTI contains an incomplete average cost with no allowance for network depreciation.

Second, a high proportion of network time is employed by educational television, a factor which has very considerably reduced the average cost previously incurred by RTI alone. Should not this reduction be regarded as one of the advantages of introducing educational television, rather than as a net cost?

This is why we insist on distinguishing between the always useful and as yet uncalculated average hourly cost of using the network, and the invoice representing the marginal cost of the service presented to educational television by RTI.

Acción Cultural Popular (Colombia): alternative methods for determining project costs

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In this study we present and discuss six alternative methods for determining project cost. Which is the preferred framework depends upon how the cost information is to be employed. Using data for the calendar year ending 31 December 1976, we then examine the costs of Acción Cultural Popular (ACPO), the Colombian radio school project.

Determining project cost

The issues involved in selecting an appropriate format for analysing project costs are similar to those encountered in choosing an appropriate budget framework for any organizational entity.[1] Decisions must be made as to how a budget will be used, the level of aggregation, and the time frame to be covered. A budget may be constructed to show historical, current, or future expenditures, expected life-time expenditures, or some combination of the above. It may also present cost rather than expenditure data. Which format is chosen depends upon whether the purpose of the budget is to provide an historical picture of an organization's operation, serve a management or planning function, enable programme planners to choose among alternative outputs, or fulfil some other evaluation need.

1. J. Burkhead, *Government Budgeting*, Chapter 6, New York, Wiley, 1956.

In a similar fashion, analysis of the expenditures or costs of an educational technology project may serve to provide historical data so that other countries can decide whether to replicate it, to enable a project manager to know whether an ongoing project is spending within its budgeted limits, to facilitate choice among alternative projects, and/or to provide cost data for effectiveness analysis.

Precisely because the data needed for management or accounting purposes differ from those needed to evaluate project effectiveness, the initial step in project evaluation is to determine the uses of the data. Where resource allocation issues are involved, cost analysis rather than expenditure analysis is required.

Physical resource accounting

At the aggregate level, analysts sometimes group projects in terms of the physical resources they employ. We shall refer to this as 'physical resource' accounting. This is useful in cases where resources are scarce and public policy imposes constraints on the particular quantity or type of resource that can be employed. It is also useful where a particular resource such as labour is in oversupply and where balanced growth depends on the adoption of projects which utilize this resource.[1]

In somewhat less aggregate terms, this type of accounting is also used in international comparisons to reflect the relative intensities of resource use of a project or organization. For example, military analysts compare the number of missiles of the armies of the Union of Soviet Socialist Republics and the United States of America in analysing the resource claims that defence makes on the two societies.[2] Analysis of this type eliminates the need to allow for imperfect exchange rates or for other problems caused by valuation of projects in terms of different currencies.[3] A disadvantage is that resource accounting implicitly assumes homogeneity of inputs and thus makes no allowance for qualitative differences among them. None the less, properly constructed, a physical resource accounting scheme can be useful in describing a project's impact on world resources.

Input accounting

Expenditure data for a project are usually collected for management and control purposes, using categories less broad than those described above. For example, the federal budget document for the United States reports

1. This is especially the case in developing countries where capital is scarce and labour is abundant. See, for example, W. F. Illchman and R. C. Bhargava, 'Balanced Thought and Economic Growth', in D. K. Wilbers (ed.), *The Political Economy of Development and Underdevelopment*, New York, Random House, 1973.
2. C. J. Hitch and R. McKean, *The Economics of Defense in the Nuclear Age*, Chapter 2, New York, Athenum, 1966.
3. For example, the existence of a large non-market sector.

such items as personnel, supplies, travel, etc.[1] A framework such as this enables decision-makers to evaluate alternative entities in terms of a common set of expenditure categories. If one entity has expenditures out of line with another's, the analyst using this scheme is likely to reduce its spending. This procedure is a time-honoured one among management analysts and it facilitates the regulation of large agencies by a fairly limited number of personnel.[2]

We refer to this type of accounting as 'input accounting' because it focuses on the various input expenditures made on behalf of a project or set of projects.

Input accounting is of limited usefulness in project analysis; it focuses on what a project uses as an input rather than on what it outputs. It is far more useful as a means of determining whether funds were spent as they were intended to be, rather than as a means for exploring whether there was a better way to perform a given task or set of tasks. This approach is more useful for accounting than for economic planning purposes.[3]

Functional accounting

An alternative form of accounting scheme often employed for management and control purposes involves a breakdown of expenditures by the organizational units which make them. The purpose of this type of analysis is primarily to pin-point with greater precision than in an aggregate analysis those responsible for the expenditures of a project or organization. For educational technology projects undertaken on a small scale, an accounting scheme of this type makes little sense; where the educational project is ongoing and administered by a large organization, a presentation of this type can be extremely useful in establishing accountability. Inordinate amounts spent on administration, large expenditures for radio transmission facilities, excess expenditures for support services can all be ferreted out by this type of presentation. The key to a good analysis lies in the choice of appropriate categories.

A functional accounting framework is often favoured by those interested in public administration; it can also be found in several comparative studies of organizations.[4] It is well suited for analyses concerned

1. See, for example, *Budget of the U.S. Government Fiscal year 1977–1978*, Washington, D.C., Government Printing Office, 1976.
2. An excellent analysis of the budget process and defence of incremental budgeting may be found in A. Wildavsky, *The Policits of the Budgetary Process*, Boston, Mass., Little, Brown, 1964.
3. Input accounting can be used in a cost framework as well as in an expenditure framework. Thus, the last point is more a critique of the way the technique is used than of the technique itself. In the estimates presented in this chapter, we provide a cost-based set of tabulations which overcomes this objection.
4. I. Sharkhansky, *The Politics of Taxing and Spending*, New York, Bobbs-Merril, 1969.

with the organizational process and has been employed frequently for this purpose. Its use for resource allocation purposes is somewhat limited by the fact that it focuses on the allocation of funds across units rather than across outputs. This has at least two consequences. Where an organization produces a single output, this framework fails to relate the inputs used by each organizational entity to the outputs it produces. Likewise, where an organization produces several outputs, this framework usually fails to provide data on how the expenditures made by each entity relate to each of its outputs. Thus, it is difficult to discern from this accounting framework whether output could be increased by shifting resources from one organizational entity to another or which alternatives are available to perform a particular task or group of tasks.

Educational input accounting

This involves a breakdown of project or organizational expenditures according to the type of educational delivery system used. We refer to the various media used in this context as 'educational inputs'. Thus, 'educational input accounting' represents a fourth accounting scheme.

Educational input accounting is useful in analysing the amount of funds that an organization spends for different types of educational media. Ideally, a classification scheme which reveals the relative amounts spent on each input would indicate the value attached to each of the inputs by project decision-makers. This would be the case where the marginal contribution to output of each input was known and if cost, rather than expenditure, data were used in this context. Unfortunately, the contribution of each of the delivery systems used to provide education to the user may not be known with sufficient precision to suggest that decision-makers choose a particular configuration based on an output measure. More likely, the rates assigned to each of the educational inputs reflect institutional, political or historical circumstance.

The educational input framework is likely to be favoured by those in fields that focus on different educational technology delivery systems, especially those in communication.[1] Since this framework provides data on the expenditures made for each of several delivery systems, it is appropriate for analysis of the difference in the way that organizations employ new forms of technology. It is also helpful in enabling those contemplating the use of a particular delivery system to gain an idea of what it might cost.

As in the case of the earlier frameworks, educational input

1. See J. Braun, 'Comunicación, Educación no Formal y Desarrollo Nacional: Las Radio-Escuelas Colombianas', Bogotá, ACPO, 1976; S. Brumberg, 'Los Medios Masivos de Comunicación al Servicio del Desarrollo Rural en Colombia', Bogotá, ACPO, 1974; S. Musto, 'Los Medios de Comunicación Social al Servicio del Desarrollo Rural. Análisis de Eficiencia de ACPO-Radio Sutatenza', Bogota, 1971.

accounting provides little guidance as to which form of technology is the most efficient and it is of limited value from the point of view of decision-making. Unless the ultimate question faced by the decision-maker is not which output to choose but rather how much to spend on each educational input, this framework diverts attention from the ends of policy and focuses instead on the means.

Programme cost accounting

A fifth form of accounting scheme involves the costing of programme outputs. This method, known as 'programme cost accounting', requires that the researcher identify the outputs of a particular project and assign resource costs in accordance with how each resource is employed in the production of each output. This is seldom an easy task given the problems associated with identifying programme outputs. We have discussed these problems elsewhere.[1] Output categories are usually derived from the objectives announced by a project's directors. As a consequence, some of the unintended outcomes of a project are likely to go unmeasured.

Programme costing came into favour largely as a consequence of the United States federal agencies' move to a Program-Planning-Budgeting System (PPBS) in 1965.[2] PPBS has proved to be a useful management and planning tool, especially in the Defense Department and it is the budgeting technique most frequently preferred by economists. It is also the approach most useful to those who wish to undertake a benefit or effectiveness/cost analysis.[3] From a resource allocation point of view, programme costing provides a framework within which decision-makers can choose from among competing programmes those which are believed to be most important from their own organization's (or from society's) point of view. In contrast to the earlier schemes, the focus is on the outputs, not the inputs of a programme.

As in the case of the other frameworks, however, this approach is not without its weaknesses. Critics of programme costing argue that it gives rise to political and ideological conflicts at budget review time which do not arise when input accounting is used. This charge is likely to be more serious where we are talking about a large multi-output organization rather than a small-scale field project. None the less, the need

1. H. Tuckman and T. Nas, *Educational Technology in Developing Countries: The Allocation Issues*, Washington, D.C., USAID, 1978.
2. The executive order promulgated in 1965 was terminated in 1971. During this period, more than twenty-five federal agencies made an attempt to utilize this technique. For an evaluation of its success see, *The Analysis and Evaluation of Public Expenditures: The PPBS System*, Vol. 1, Joint Economic Committee, ninety-first session, Washington, D.C., Government Printing Office, 1969.
3. The conceptual underpinnings of these techniques appear in Richard A. Musgrave, 'Cost-benefit Analysis and the Theory of Public Finance', *Journal of Economic Literature*, September 1969.

under this approach to identify the outputs from a dollar of additional funding creates problems which do not exist with the other cost modes.

Programme costing may also require data that are not available to an organization or that are costly to obtain. As a result, the output cost estimates may be somewhat subjective. The argument is also made that in the absence of better effectiveness criteria, it is difficult to choose among alternative programmes, especially at the aggregate level. While it may be efficient to choose between bombers and foot soldiers on the basis of the number of enemy killed per dollar expended, no easily derived measures exist for evaluating the effectiveness of a range of spending programmes in basic and health research, income maintenance, and certain regulatory areas.

It is our belief that the programme-costing approach has value in project evaluation, especially in dealing with educational technology projects which produce several outputs. While each of the above objections has merit, most projects are undertaken in an environment where resources are scarce, particularly in developing countries. Within this context, the choice among competing programme outputs is likely to be an important, albeit not a simple, one.

Technology components accounting

Our final classification scheme has been designed explicitly for evaluating instructional radio projects.[1] Its purpose is to provide a standardized accounting for international projects in terms of programmatic components such as production, programming and distribution. 'Technology components accounting' is quite useful where a project has a single output. Where multiple outputs are involved, the same objection may be made to this procedure as to the input accounting classification described above.

This approach is valuable because it enables those interested in analysing instructional radio projects to make comparisons in terms of how their costs were split among the three types of activities. In this sense, it makes explicit the trade-off among the alternative uses of scarce funds. Paralleling the work done by Jamison *et al.*, a framework of this type enables researchers to produce somewhat crude cost functions which relate the variables likely to determine costs to the actual costs of a project.[2]

The components accounting approach is best suited for analytic

1. See J.-C. Eicher, 'Cost-effectiveness Studies Applied to the Use of Educational Media', p. 11–26, and F. Orivel, 'Standard Tables for Cost Measurement', p. 26–35 in *The Economics of the New Educational Media*, Vol. 1: *Present Status of Research and Trends*, Paris, Unesco, 1977 (Educational Methods and Techniques, 1).
2. D. T. Jamison, S. J. Klees and S. J. Wells, *Cost Analysis for Educational Planning and Evaluation: Methodology and Application to Instructional Technology*, Princeton, N.J., Educational Testing Service, 1976.

rather than for accounting or management purposes. For this reason, it is likely to appeal to those most interested in evaluating the determinants of differences in costs among instructional radio programmes. Its major supporters to date have been economists, although engineers concerned with the design of radio projects might also find the data obtained by this approach useful.

While components accounting is designed to facilitate comparisons of instructional radio or radio school projects in different countries, it does not enable the analyst to explore the question of which among several alternative media forms might be best for providing a particular educational output or set of outputs. For this reason, it appears to implicitly rule out broad resource allocation issues between media. However, this is not a problem if the choice of instructional radio as the desired media form has already been made. In this case, the components approach allows the decision-maker to decide whether to allocate more funds to programme design or more to increasing coverage. It is difficult to see how this type of framework can be used in conjunction with effectiveness criteria since, like some of the other measures discussed above, its focus is on the inputs of a project rather than the outputs.

A specific application of the alternative cost frameworks

In the sections which follow we apply the budgetary frameworks discussed above to a multi-output organization with a view to illustrating their use. The data are derived from a study of Acción Cultural Popular (ACPO), which has been in existence for over thirty years. Financed by USAID, and conducted with the co-operation and assistance of ACPO, this comprehensive study involves a two-year evaluation of ACPO's costs and effectiveness.[1] Given its large size, its commercial activities, and its comparatively long record of survival, ACPO provides a good example of how different cost configurations can be applied in analysing the resources used by a large and complex organization.

ACPO has largely restricted its educational activities to the rural *campesinos* (farmers), and in the process it has gained useful insights into how to deal with this group. It applies a guiding philosophy designed to provide a complete education for its target audience. Applying a concept called 'fundamental integral education' (FIE), it deals not only with the development of basic literacy skills, but also with the various types of knowledge necessary for the *campesino* in his or her daily life. Education as ACPO sees it is concerned with improvement of the environment. It is a means of reaching self-development and not an end in itself.

1. This grant was given to the Center for Educational Technology at Florida State University in Tallahassee.

In pursuing its objectives, ACPO has developed an infrastructure which extends country-wide. Its transmitters broadcast throughout Colombia; its newspaper *El Campesino* is distributed even in the sparsely populated regions of the country. ACPO's leadership training institutes provide a comprehensive programme for community leaders; its correspondence programme provides feedback from the *campesinos* on all phases of the operation. Few other organizations in Latin America have developed as intensive an approach to the education of the rural poor; none have articulated their philosophy as extensively as has ACPO.

The ACPO organization is privately owned and operated. Chartered as a private foundation by the Colombian Government in 1949, it exists with recognition from both the Church and the State. Its board of directors is composed of persons from education, industry and commerce in Colombia; it also has an advisory board made up of officials from the Colombian Catholic Church. Because ACPO is private, it cannot count on financial support from the government. It received aid from the Colombian Government from 1954 to 1975.

ACPO's need to raise a portion of its own revenues has had several consequences for its operation. It has been forced to find internal sources of revenue to finance itself. Since rural farmers in Colombia have only limited resources to support ACPO, the organization has established an elaborate commercial operation to support its rural activities. ACPO sells advertising on its long-wave and short-wave radio broadcasts and through the newspaper. Its business subsidiary, Editorial Andes, prints calendars, books, Christmas cards and boxes for children's toys, and its record press produces popular records. It also produces educational records containing the lessons broadcast by ACPO's radio stations.

For present purposes, it is sufficient to note that substantial reliance on commercial activity as a source of revenue distinguishes ACPO's operation, at least in degree, from the other radio schools in Latin America.

Overview of ACPO's educational inputs

The educational input mix which ACPO currently employs is not the one initially chosen by its founders. Instead, the input configuration has evolved as ACPO has gained experience in what is needed to bring the elements of a basic education to non-literate people. The choice of instructional radio as the primary form for providing education was made at the outset of the programme, largely in response to ACPO's need for a medium which could reach people in inaccessible parts of the country. At first, education was provided via a small transmitter (100 watts) with a very limited range. The initial group of 120 listeners received instruction in groups, using borrowed radios to tune in to the transmission. In subsequent years, ACPO has imported and sold low-cost radios to encourage

listener participation. It has also increased the size of its facilities. The current instructional radio configuration involves both A.M. and short-wave transmission facilities and ensures virtually 100 per cent coverage of the potential audience.

A second educational input used by ACPO involves a set of topical booklets covering the five major output areas. Designed with the assistance of Unesco experts, these provide basic instruction through simplified concepts and graphics designed to stimulate the interests of the *campesino*. Despite their popularity and strong evidence that they are highly regarded by the *campesinos*, they have not been altered or added to in the last eight years.

El Campesino, the ACPO newspaper, was a comparatively late addition to the scene. Prior to its inception, ACPO produced several publications, primarily to reach its radiophonic school monitors and advanced pupils. The idea of a newspaper to reach the population served by ACPO came later. It was appealing precisely because it both promoted communication and identification among *campesinos* and provided educational information. The newspaper contains stories involving the content of each of ACPO's learning areas as well as other features. It also contains supplements which deal with special issues selected by ACPO. No other newspaper in Colombia addresses itself exclusively to the *campesino* and his needs.

Educational phonograph records containing the basic materials taught on ACPO's instructional radio broadcasts were first introduced in 1974. These enable *campesinos* unable to listen to the radio to have access to the basic instructional materials of ACPO.

A correspondence programme provides a source of communication between the *campesinos* and staff in the Bogotá facility. *Campesinos* are encouraged to correspond with ACPO about the ideas they receive while using other instructional inputs. The correspondence is usually answered by regional staff located in ACPO's central office.

Perhaps the most important support activity developed by ACPO, and one which also serves as a learning device, is the training institute. Inaugurated in 1954, the institute has expanded into three units which periodically produce a class of paraprofessional teachers. These persons supplement their education at the institutes and then go into the field to assist, form, and/or supervise radio schools. The ACPO structure creates a career cadre of informed and dedicated paraprofessionals. It also provides entrants to the institutes with additional education they would be unlikely to receive from other sources.

These are the elements of ACPO's delivery system as they have evolved historically. Together they form the system through which ACPO delivers its educational message.

The tabular presentations

For the purposes of our presentation, certain modifications are made in the classification schemes listed above. A major change is that a cost-based budget rather than an expenditure budget is used for the five-budget frameworks involving dollar figures. The primary difference between an expenditure and a cost approach is that the former treats capital costs on an annualized basis, excludes expenditures which do not involve the use of real resources, and eliminates certain accounting items for interest and depreciation. The resulting estimates more closely represent the actual claim that ACPO makes on resources than do figures derived from the usual accounting entries.

Because ACPO has a commercial as well as an educational function, the figures shown in each of the budgets must be analysed carefully. In the tables involving aggregate comparisons, i.e. the physical resources, input, and functional accounting budget, the figures include the combined costs of the commercial and educational enterprise. In the educational input—programme costing and components analysis—only the educational elements are included. We have followed this procedure to conform with the needs that each of these presentations is intended to meet.

Finally, the reader is cautioned that our figures are the December 1976 operating costs of the organization. Given the lack of historical data on the operation of ACPO, it was impossible to reconstruct historical costs.[1] Thus, our estimates represent a snapshot taken at a moment in time, not a reckoning of full project costs.

Physical resource accounting

The purpose of physical resource accounting is to provide quantitative information on the major resources employed by an organization. Like other large organizations, ACPO has accumulated a substantial number of resources in thirty years. Its inventory sheets alone number over 2,000 pages. For present purposes, we have chosen to list only the largest and most important. In the cost estimates which follow, however, we have included a price for each item in the ACPO inventory. To facilitate the analysis, the resources are divided into the aggregate capital and labour categories. They are further subdivided by each of the twenty-one ACPO divisions, identified in terms of their organizational functions.

1. Data could be obtained back through the early 1970s by reconstruction of ACPO's actual expenditures from bank records. Beyond this point, however, the expenditures become difficult to trace.

Manpower requirements of ACPO

Data on the number of persons employed by ACPO and on their costs are derived from personnel records as of 31 December 1976. All employees except those unpaid personnel who are *dirigentes*, or immediate auxiliaries, are included. The exclusion of the latter two groups is due to the lack of accurate records on how many persons are employed in these activities and the duration of their employment.[1]

The possibility exists that our figures understate the true manpower requirements of ACPO since they ignore persons on the pay-rolls during some part of the year but not employed on 31 December. Given the high unemployment rate in Colombia, and the low turnover at ACPO, this figure is not likely to be greater than 2 per cent of the total manpower used by the organization.

Table 1 shows the number of employees and their cost for each division of the organization. The data are classified in terms of administrative services, home, and field activities. The largest labour cost, almost 23 per cent of the total, is incurred in the provision of administrative services. This division's employees are involved in activities related to accounting, auditing, and general services. A related high-costs administrative unit (17.4 per cent) is the regional division. This entity supervises and co-ordinates the work of the leaders, *dirigentes*, and supervisors, answers correspondence, and serves as ACPO's liaison with units in the field. The Planning and Evaluation Division, and the Sales and Design Division, are low-cost divisions relative to the others. Employees of the

TABLE 1. Distribution of ACPO manpower by division

Division	Number of employees	Cost (in 1976 U.S.$)	Percentage of total
Administrative services	114	373,285	22.7
Planning and evaluation	15	49,576	3.0
Sales, design	20	51,454	3.1
Printing press	166	334,304	20.3
Record press	10	16,015	0.9
Radio stations	119	226,770	13.8
Institutes	43	99,433	6.0
Cultural divisions	20	66,104	4.0
Regional divisions	331	286,363	17.4
Other support services	21	25,274	1.5
Miscellaneous services	—	114,614	6.9
TOTAL	859	1,643,192	100.0

Source: ACPO personnel records, December 1976.

1. We provide a rough measure of the value of these resources in our high cost estimates for ACPO at the end of the chapter.

former deal solely with educational activities; the latter deal mostly with the promotion, sale and distribution of ACPO materials.

The fourth largest user of labour, measured in terms of dollars, is constituted by the radio stations. It is interesting to note that this category has comparatively few persons assigned to it; 119 as compared with 166 in the printing press unit. The labour costs in the institute category include teacher's salaries, scholarships for trainees, and all other related outlays. The entry for the cultural division includes the salaries both of employees of the cultural division and of teachers located in ACPO's central office. Finally, the regional division category contains the salaries of those employees in the central departments and zone offices who provide communication services to staff and *campesinos* in the field.[1]

Capital items

Table 2 displays the major capital items and their costs measured in 1976 U.S. dollars.[2] It provides a physical description of the resources used by ACPO and is an invaluable source of the data for the following section.

Although we have made a concerted attempt to identify all of the resources used by ACPO, certain items remain outside our accounting framework; the amount they add to total costs, however, is not likely to exceed 20 per cent. They include the labour and capital items donated by *campesinos* and not carried on ACPO's records; time spent by non-ACPO staff in establishing and attending the radio schools, and the space and other support services provided to ACPO by persons in religious, governmental and local community organizations. We have also made

1. Except in the case of the radio stations and cultural division, the employees in these divisions allocate 100 per cent of their time to educational activities. The radio stations utilize 46 per cent of their employees' time for educational activities, whereas the cultural division's employees devote 80 per cent.
2. Data on both the number of capital items and their value are obtained from a special document prepared in 1976 by ACPO for the World Bank: *Acción Cultural Popular, 30 Años, Un Sistema de Medios de Comunicación Social al Servicio de la Educación del Campesino Colombiano.* This volume contains information on the major ACPO equipment and building cost items. It excludes start-up and installation costs and minor capital items. The 'equipment' category includes transportation items that last more than one year and such items as mimeograph machines, transmission equipment, phonographs, slide projectors, radios, etc. Our data for each entry in this category include the purchase price, current market value, and estimates of the useful life of each piece of equipment employed by ACPO. The 'building' category covers all buildings used by the employees for ACPO purposes, whether rented or owned.

   Other capital items such as vehicles, furniture, machinery, and laboratory equipment, etc. are obtained from a physical inventory prepared during February, 1977. This inventory lists all physical assets owned by ACPO and the value of each. The data that we report are derived from this inventory with several changes made to more closely reflect the market rather than the book value of each item.

TABLE 2. Dollar value of capital items used by ACPO in 1976

Item	Description	Cost (U.S.$)	
Transmission facilities			2,055,407
Radio Bogotá	250-kW transmitter	571,820	
	50-kW transmitter	171,546	
	25-kW transmitter	100,069	
	10-kW transmitter (2)	108,646	
	187-m. antenna tower	28,591	
	F.M. link	51,464	
	Telex	2,287	
	Laboratory equipment	3,430	
Radio Medellín	100-kW transmitter	285,910	
	200-m. antenna tower	36,025	
Radio Barranquilla	10-kW transmitter	51,464	
	120-kW transmitter	285,910	
	15-m. antenna tower	2,287	
	72-m. antenna tower	4,289	
	156-m. antenna tower	28,591	
Radio Cali	120-kW transmitter	285,910	
	204-m. antenna tower	37,168	
Studios			142,955
Bogotá		57,182	
Barranquilla		28,591	
Medellín		28,591	
Cali		28,591	
Buildings			4,753,202
Radio transmission		617,566	
Institutes		177,036	
Central services		3,618,939	
Printing press		74,108	
Other		265,553	
Machinery and equipment			3,822,290
TOTAL			10,773,854

Source: *Acción Cultural Popular, 30 Años, Un Sistema de Medios de Comunicación Social al Servicio de la Educación del Campesino Colombiano*, internal document, 1976; and 'ACPO Physical Inventory', February 1977.

no attempt to value the opportunity cost of the time that participants spend in such ACPO programmes as the training institutes since serious conceptual problems arise in this regard that would require a separate paper.

Table 2 shows only a part of the total physical resources used by ACPO, confining its enumeration of items to the major capital items. None the less, it is useful in highlighting the large share of total capital costs dictated by machinery and equipment, the central services building in downtown Bogotá, and ACPO's radio transmission facilities in four major locations. Most striking is the large array of transmitters and transmitter facilities used to provide 100 per cent population coverage. Over seven transmitters are available to ACPO to reach into the mountainous

areas. The regional distribution of studio facilities should also be noted. Viewed in terms of capital resources used, these figures suggest that, at least as it is now organized, ACPO is an expensive organization.[1] They also suggest that the larger capital items are primarily related to the radio transmission and to the commercial printing operations. We shall discuss these points further in the analyses which follows.

Cost breakdown by input category

The input accounting approach is useful in evaluating ACPO from the perspective of the types of broad categories of inputs which it uses. In the presentation that follows we shall modify the traditional input budget so that the entries in each category represent costs instead of expenditures. This will facilitate comparisons among the various budget alternatives.

Table 3 shows the annualized operating costs of ACPO broken down by major resource input categories. The cost figure for the 'labour' category is taken from Table 1. Annualized operating costs for supplies, transportation, and the overhead and other categories are taken from the ACPO operating budget and allocated on the basis of conversations with ACPO staff. The 'supplies' category contains only expense items which last less than one year such as paper, pencils, etc. The 'transpor-

TABLE 3. Annualized ACPO costs by input category

Item	1976 U.S.$	Percentage
Labour	1,643,192	34.9
Buildings[1]	496,292	10.6
Supplies	957,517	20.4
Equipment[1]	810,775	17.2
Transportation	189,062	4.0
Overhead and miscellaneous	608,477	12.9
TOTAL	4,705,315	100.0

1. The figures in this entry represent the capitalized amount for this category.

Sources: Tables 1 and 2 and ACPO's operating budget, December 1976.

1. The capital cost figures included in Table 2 are based on ACPO's own evaluation of the worth of each capital item. There are several reasons for believing that these may be low: (a) it is unlikely that the 'market' values used by ACPO include installation costs; (b) a country seeking to replicate this configuration would use more modern equipment which is likely to be more costly; (c) given the high rate of inflation in Colombia in the last few years, the buildings owned by ACPO are likely to be under-assessed. We shall consider a higher cost estimate at the end of this chapter.

tation' category includes per diem and travel expenses related to ACPO activities plus amounts paid for the transportation of goods and services.

Items with a lifetime longer than one year are treated as capital goods and annualized in accordance with different time periods for each type of asset.[1] For buildings, the average expected life is estimated to be thirty-five years; for transmission equipment, machinery and average or new furniture, fifteen years; for old furniture and studio facilities, ten years; and for miscellaneous equipment, five years. These time periods are based both upon joint discussions with ACPO staff and guidelines applied in previous cost studies.[2] A discount rate of 10 per cent is used in annualizing the capital items.[3]

The 'overhead and miscellaneous' category contains items not classified elsewhere, such as: advertising and publicity, electric power and water, repair and maintenance, and miscellaneous outlays. Expenses incurred for donations made in cash to welfare entities or to third parties are excluded since they do not involve real resource use. Similarly, tax payments of various kinds such as sales, vehicle and valuation taxes are excluded since they do not involve a real resource cost directly resulting from the project's operation. Finally, interest payments, net of commissions to banks, are not included in our cost estimate; some capital costs are taken into account in the annualization formula.

About 35 per cent of ACPO's annualized operating costs are incurred for labour inputs. In contrast, buildings and equipment, the major capital items, represent only 27.8 per cent of the total or a little over 70 per cent of labour costs. That ACPO's operation is labour-intensive is self-evident. Two things are not clear from Table 3, however. First, ACPO pays comparatively little salary to its field staff. In part, it can afford to do this because of the low return to employment in rural areas. If Colombia had an unemployment rate closer to that of the industrial nations, ACPO's bill would almost surely be higher.[4] In part, ACPO can also afford to pay lower salaries because of its identification

1. For the formula used to annualize the capital items, see Tuckman and Nas, op. cit., p. 111.
2. See M. Carnoy, 'The Economic Costs and Returns to Educational Television', *Economic Development and Cultural Change*, Vol. 23, No. 2, 1975, p. 207–48; see also, D. T. Jamison *et al.*, op. cit., p. 14–20.
3. Economists disagree on what is the correct discount rate to use in studies of this type. Some believe that the correct rate is the social opportunity cost of capital; others that the correct rate is the social time preference rate. Given the absence of data on either rate for Colombia and the other problems inherent in adjusting for both the high rate of unemployment and the high rate of inflation, a discount rate of 10 per cent was chosen for this study. Alternative rates are employed in our section dealing with alternative cost estimates. For a discussion of the issues see R. F. Mikesall, *The Rate of Discount for Evaluating Projects*, Washington, D.C., American Enterprise Institute, 1977, Chapter 2.
4. It is likely that under these circumstances ACPO would use less labour in the field. This would at least partially affect the pay-roll of ACPO, reducing the field force by an amount difficult to determine in the absence of better data.

as a church-related organization. Persons affiliated with this type of activity almost surely receive spiritual as well as monetary rewards. Second, the ratio of capital to labour will vary depending on which discount rate is used to annualize capital costs. A 7.5 per cent discount rate changes the ratio of capital to labour to 50 per cent; a 15 per cent discount rate changes the ratio to 95 per cent.

It should also be noted that these figures fail to reflect the intensity of utilization of each factor. A highly labour-intensive operation may none the less show a large ratio of capital to labour costs if capital is scarce relative to labour. It seems likely that this was the case in Colombia at the time of our evaluation since the government restricted the amount of capital that could be employed in the private sector.

Cost breakdown by functional accounting category

Table 4 provides a breakdown of total annual operating cost by division.[1] Once again, the figures include overhead which ACPO incurs, representing about one-fifth of the budget, or over one-quarter of the budget if other support services are included.[2]

Table 4 contains comparatively few surprises. However, it indicates

TABLE 4. Annualized ACPO costs by functional accounting unit

Division	Cost (U.S.$)	Percentage of total
Administrative services	922,676	19.6
Planning and evaluation	73,353	1.5
Sales and design	228,548	4.9
Printing press	1,418,619	30.1
Record press	108,247	2.3
Radio stations	904,233	19.2
Institutes	290,221	6.2
Cultural divisions	108,088	2.3
Regional divisions	356,801	7.6
Other support services	294,539	6.3
TOTAL	4,705,315	100.0

Source: See text.

1. The operating figures are obtained from ACPO's actual operating budget and are allocated to each division using the accounting procedures of the ACPO organization and the economic cost-accounting framework described above. Where costs could not be traced directly to a department, the best judgements of the planning and evaluation staff were used to assign them.
2. For more on our methodology for computing these figures, see Tuckman and Nas, op. cit., appendix.

two interesting aspects of ACPO's operation. First, the organization spends comparatively little money on sales and design, preferring to make itself known primarily through its field staff. This may be a reflection of the fact that after thirty years of operation, ACPO is well known among its constituents. It may also reflect the fact that comparatively few funds are left over for these types of operations because of the high cost of ACPO's other activities. Second, if ACPO's field activities are adequately represented by the entries in the regional and institute categories, then the ineluctable conclusion is that it is essentially a highly centralized organization. The regional staff takes a surprisingly small amount of ACPO's total resources.[1]

Cost breakdown by educational input

In this section, we provide cost estimates which most closely represent the costs of each of the several delivery modes used by ACPO to provide education to rural *campesinos*. These figures should be especially interesting to those concerned with studying differences in the allocations that various organizations make to competing (or complementary) delivery modes. To enable the reader to follow more closely the way in which ACPO allocates its resources for educational purposes, we have isolated its commercial operations from its educational activities and placed the former in a distinct category. Thus, each of the entries in Table 5 except the last one contains costs related solely to ACPO's educational operations.[2]

A caveat is in order as regards interpretation of the training institute entry. On the one hand, the institutes may be treated as an intermediate rather than an end product. This is because their major purpose is to train *campesino* leaders to bring the educational media to rural *campesinos*. Thus, it might seem logical not to treat the institutes themselves as a separable delivery vehicle but rather as a supplement to the other educational inputs. However, it may also be argued that the institutes provide

1. It is likely that a careful enumeration of ACPO's field staff might increase the estimate of the number of employees in the field shown in Table 1 by as much as twofold. However, such an estimate would have to be based on a careful computation of the actual hours spent on ACPO activities. We are confident that when this was done, our conclusions would hold.
2. A conceptual problem exists in the treatment of the general activities category. To the extent that commercial activities inflate this category, the unique costs attributable to this source of resource use should be allocated to the last category. However, at least some administrative personnel would be employed whether ACPO had a commercial side or not. The problem is to identify the *unique* expenditure due to commercial activities and remove them. In Table 5 we have included commercial activities in the general activities category.

TABLE 5. ACPO costs by educational input category (U.S.$)

Category	Operating cost	Investment cost	Total cost	Percentage of total
Radio	250,081	195,197	445,278	9.5
Booklets	67,321	19,401	86,722	1.8
Newspapers	357,241	38,578	395,819	8.4
Study records	23,108	1,422	24,530	0.5
Books	124,537	19,844	144,381	3.1
Correspondence	57,579	1,119	58,698	1.2
Institutes	491,639	36,050	527,689	11.2
General activities	715,190	384,010	1,099,200	23.4
Commercial operations	1,296,346	626,652	1,922,998	40.9
TOTAL	3,383,042	1,322,273	4,705,315	100.0

Source: See text.

a form of education which is inappropriately included in any other category because they enable the persons they train to obtain an education which such persons would otherwise not receive.[1]

The cost figures for each educational input category are derived as follows. The operating costs for each department are allocated across educational input categories according to the percentage of time or effort spent by each division in each activity. Annualized capital costs are then computed with allocation of the proportion of space or the quantity of time employed by capital item in each activity. The operating and capital costs of each educational input are then added across divisions to arrive at a total dollar figure for each category.

The training institutes command the largest share of total educational costs (11 per cent of the total). This finding was obscured in the earlier budget formats because a substantial portion of ACPO's printing and broadcasting activity is for commercial purposes. The training programme provides an important formal component which is often unrecognized because of ACPO's reputation for spiritual training. While educational radio reaches many more people than the training institutes, the latter provide an important source of training to leaders in rural Colombia. The institutes occupy a fairly large plot of land, consist of several buildings, and hire a cadre of teachers. Thus, it is not surprising that they command a large, albeit not dominant, share of ACPO's total costs.

ACPO's radio facilities and its *campesino* newspaper each represent about 9 per cent of total educational costs. The significant decline in the share of the total commanded by radio relative to the figures reported in earlier tables reflects the large proportion of total broadcast time which

1. For more on the difficulties associated with classifying this hybrid type of cost, see Hitch and McKean, op. cit., p. 52–9.

ACPO devotes to commercial activities. As can be seen from the Table 5, the decision to sell commercial time has the effect of reducing the educational component's share of total costs. It should be noted that since the largest costs of radio transmission involve the capital equipment, and since this equipment would have to be purchased whether ACPO sold commercial time or not, the figures reported above are likely to understate the true costs of operating an instructional radio facility of the type used by ACPO. Only in the case where an equivalent commercial operation would be mounted could one reasonably assume comparability of costs.

Comparatively small amounts are spent on the other media; 2 per cent for ACPO booklets, 3 per cent for the books, and less than 1 per cent for the study records. In part, this is a reflection of the low costs of production of these items. This is also due to the fairly low levels at which ACPO produces these items. In the case of the study records, we suspect that the relatively high price of a phonograph serves as a deterrent to the mass distribution of this item.

The last two categories in Table 5 are not directly related to the educational inputs. These claim the largest amount of ACPO's resources. The first, general activities, includes those items which ACPO uses to provide support services activities. It is a joint produce of both the commercial and educational activities and includes costs related to the labour union, food service, common buildings and land areas, vehicles, general services and administration, including accounting and auditing. The commercial activities category consists of all costs related to activities undertaken for profit-making purposes. Those include commercial time on the radio, commercial rental of the studios, advertising through the newspaper, and the non-educational operations of the printing press, and the record press. Given the problems implicit in distributing these costs, we believe it preferable to include them in a separate category.

Breakdown by programme cost (educational output)

A programme cost analysis of ACPO is useful for several reasons. First, given its multi-output nature, ACPO is difficult to analyse in functional or educational input terms. It is important to know both which inputs ACPO produces and how well it produces them in order to understand its operation. Second, in contrast to some other instructional radio programmes, ACPO attempts to change the behaviour of its participants, not simply to educate them. There is an inherent value in knowing the outputs which it believes are necessary to accomplish this goal and the weights it gives to each output. Third, presentation of the cost data by output category, represents the first step in performing a cost-effectiveness analysis.

Our methodology for obtaining programme costs is relatively straightforward. The educational input costs reported in the last section are allocated by division to each programme output element using the percentages derived from a content analysis of educational inputs.[1] The output categories are those identified by ACPO and an entry is included to take into account joint items that cannot be uniquely separated into any other output category. Table 6 presents our cost estimates in the form of an input-output matrix. The rows show the educational outputs and the bottom row corresponds to the dollar total in Table 5. The columns show the dollar value of the educational inputs used in the production of each output and the last column shows the percentage of the total dollars commanded by each output. As in the case of the earlier tables, these are the annualized total costs of operating ACPO.

While Table 6 does not suggest major differences in ACPO's allocation of costs among the educational outputs, there are some. The largest percentage of total cost is claimed by the economy and work category; the smallest percentage is spent on arithmetic. The difference between the two categories is about 4 percentage points.

Interestingly, only 36 per cent of ACPO's total resources are allocated exclusively for educational purposes; about 41 per cent are allocated for commercial activity and the remaining 23 per cent for support. If the support component is allocated to the two other categories in proportion to their respective shares of total cost, the educational component rises to 47 per cent and the commercial component to 53 per cent.[2] These figures suggest that, although ACPO's primary mission is to provide education to the rural *campesino*, over half of its resources are devoted to the production of commercial goods and services. In fact, ACPO is more of a business than an educational enterprise, at least viewed from this perspective.

In evaluating this finding it is important to understand that ACPO has been forced to seek out non-governmental revenue sources in order to survive. The dollar allocations reported in this chapter reflect an explicit policy decision to forgo some educational activities in favour of revenue raising, especially with respect to broadcast time. Had ACPO chosen not to do this, however, it would almost certainly have had to scale down its operations still further.

We make no judgement as to whether this was a wise decision for ACPO. It seems likely that ACPO would rather have devoted all of its resources to education if its financial situation had allowed it to do so. The allocations noted in Table 6 reflect ACPO's realization that to support a large operation without total government support it had to create independent revenue sources. Presumably, a substantially smaller

1. See Tuckman and Nas, op. cit.
2. The former represents slightly more than 90 per cent of the latter.

TABLE 6. Annualized ACPO costs by educational inputs and outputs (U.S.$)

Educational outputs	Educational inputs								
	Radio	Booklets	Newspapers	Study records	Books	Corre-spondence	Institutes	Total	Percentage of total
Literacy	78,814	21,767	7,521	12,265	6,064	11,739	90,235	228,405	4.9
Arithmetic	78,814	21,767	8,312	12,265	3,032	11,739	32,717	168,646	3.6
Health and nutrition	56,550	14,396	6,333	—	36,817	11,740	52,241	178,077	3.8
Economy and work	56,550	14,396	91,434	—	64,538	11,740	120,313	358,971	7.6
Spirituality	89,946	14,396	85,497	—	21,657	11,740	115,036	338,272	7.2
Joint	84,604		196,722	—	12,273	—	117,147	410,746	8.7
General activities	—	—	—	—	—	—	—	1,099,200	23.3
Commercial operations	—	—	—	—	—	—	—	1,922,998	40.9
TOTAL[1]	445,278	86,722	395,819	24,530	144,381	58,698	527,689	4,705,315	100.0

1. Note that the totals at the bottom of each column do not add up to overall total for this row. This is because general activities and commercial operations do not appear in the columns.

Source: See text.

operation might be financed without the need for commercial activity. But this would clearly have an impact on the proportion of the rural *campesinos* reached.

Cost breakdown by components accounting

Our final breakdown of ACPO costs is based on a common components classification scheme developed under the auspices of Unesco.[1] This classification scheme has four components. The 'conception' category includes those cost items which involve the formation and conceptualization of educational materials. The 'production' category includes all cost items concerned with the production of instruction and instructional materials. 'Transmission and distribution' involves the cost of those activities associated with fielding educational materials. Finally, the 'reception' category contains cost items directly associated with obtaining or utilizing the instructional materials.

While this taxonomy is quite useful in facilitating comparisons between instructional systems, it is less informative than several of the earlier breakdowns. Its major value is that it allows for a common comparison of instructional radio projects across countries.

Due to ACPO's unique characteristics, particularly its commercial operations and multi-media approach, the Unesco classification scheme is somewhat difficult to utilize. To use this approach in a constructive manner, we have modified it somewhat. Our changes are reflected in Table 7.

Note that the planning and evaluation category corresponds to Unesco's conception category, and includes time spent preparing and conceptualizing radio programmes, newspapers, booklets, etc. Since the ACPO project is already under way, all resources devoted to the evaluation of ongoing ACPO programmes are included in this category. Both

TABLE 7. ACPO costs by components categories

Category	Cost (in 1976 U.S.$)	Percentage of total
Planning and evaluation	311,693	6.6
Production	1,135,387	24.2
Distribution	236,037	5.0
Commercial activities	1,922,998	40.9
General activities	1,099,200	23.3
TOTAL	4,705,315	100.0

1. J. C. Eicher, op. cit., p. 17–21.

production and distribution correspond to the Unesco breakdown. The former involves all operations concerned with producing educational materials; the latter includes radio transmission equipment, vehicles used to transport educational materials and the persons who assist in using them, and all other capital goods and salaries related to bringing ACPO's message to the field. The reception category is excluded since serious problems exist in gathering information on this aspect of ACPO's programme.[1]

The Unesco scheme is further modified by adding two additional categories. These are the commercial and general activities items which correspond to the last two items in Table 5.

Alternative cost estimates for ACPO

Having completed the discussion of the six alternative accounting frameworks, we shall now find it useful to explore the possibility that our cost estimates do not accurately reflect the true cost of ACPO. In any study of this type there are several uncertainties which surround the choice of items for inclusion in the analysis. For example, the inventory records for an organization may fail to record all the capital items it uses, donated labour may be omitted from the accounting, or idiosyncratic flourishes may be added to a radio studio or training institute which are unrelated to the direct outputs of a project and unnecessary in producing a given set of outputs. Which items should be included in costing a project is a matter of judgement and reasonable men may disagree on the particular items to include or exclude in an analysis of this type. However, it seems clear that large omissions may understate the cost of providing instruction through a given medium and this can give rise to charges of bias.[2]

In recognition of these judgemental differences, we shall establish a confidence interval or set of boundary points around our estimates. Using a set of plausible assumptions about ACPO, we report a low- and high-cost estimate within which the true annual operating costs are likely to fall.

1. This category is useful where the project actually distributes radios, provides community listening facilities, or otherwise subsidizes the costs incurred by the participants of the project. It would be reasonable to include ACPO's subsidy to the newspaper and *cartillas* in this category and several other small items might also be added. However, ACPO's sale of radios would be excluded because this is a profit-making operation and because the majority of the *campesinos* own their own radios. Since reception is not the real issue in evaluating ACPO, we have excluded this category from our analysis.
2. H. Levin and M. Carnoy, 'Evaluation of Educational Media: Some Issues', *Instructional Sciences*, 4, 1975, p. 385–406.

To provide a low-cost estimate of ACPO's costs the following assumptions are made:

The entire field staff of ACPO is replaced by donated labour. This is equivalent to saying that all supervisors, leaders and *dirigentes* are unpaid.

The overhead relating to items such as the chapel, the restaurants, and other support services are eliminated.

All of the furniture utilized by ACPO is so old that it has already been fully depreciated.

The cost of the 50-kW standby transmitter in Bogotá is eliminated from the capital cost estimate since it primarily serves for back-up purposes.

A 7.5 per cent discount rate is used to annualize the estimate.

A high-cost estimate is obtained by increasing our estimate of ACPO's total costs in the following fashion:

An estimate is made of the initial set up costs of ACPO.[1] These are capitalized over a ten-year time horizon.

The assumption is made that ACPO uses 10 per cent more manpower than is reported in its official field statistics. This might be the case, for example, if church personnel aid in ACPO field operations.[2]

A dollar salary is assigned to the value of a *dirigente*'s salary equal to the salary of a leader less the difference between a supervisor's and a leader's salary. This is applied to ACPO's estimate of the number of *dirigentes* in the field.[3]

Building costs are arbitrarily increased by 10 per cent to reflect the value of donated space.[4]

The resulting cost estimate is discounted by a 15 per cent rate.

The alternative cost estimates obtained from each set of assumptions, together with the figure reported earlier in this chapter, are as follows: the low-cost estimate of ACPO's total annual operating cost is $4,002,000; the mid-range estimate, $4,756,000; and the high-cost estimate, $6,107,000.

1. The amount used in our estimate is $404,690. It is estimated by annualizing half the 1976 operating costs over a ten-year time horizon.
2. It is extremely difficult to know how much labour ACPO really uses for several reasons. First, some of the radio schools which it lists as ongoing may actually have closed down, thus resulting in a lower manpower need. Second, some of its past leaders who are no longer associated with the organization may still promote it. Third, in some parts of the country, community organizations may promote ACPO-related activities to their members. Thus, our choice of numbers is essentially arbitrary.
3. The implicit assumption here is that ACPO maintains a constant dollar differential in the salaries offered at its three field ranks.
4. Short of launching a massive new space evaluation study, we are forced to proceed by assumption.

Conclusions

The findings reported above illustrate the complementary nature of the various budgets and the differing insights that each one provides. In the case of ACPO, the physical resources and functional inputs budgets suggest the substantial capital resources employed in the printing press and radio transmission operations. Subsequent analysis of the data in the context of the educational input and educational output frameworks revealed the large proportion of ACPO's operation accounted for by its commercial activities. It seems clear that ACPO's major cost elements are related to its commercial rather than its educational activities, although it is equally clear that the former activities are necessary to allow ACPO to continue producing educational instruction on its current scale.

The current balance between ACPO's educational and commercial activities is a fragile one and ACPO faces several important decisions regarding the scale of its operations in the future. The direction it will give to its commercial operations is crucial in determining the future scale at which it will operate.

A second insight which emerges directly out of the functional accounting budget and which is also obvious from the educational input and educational output budgets is that ACPO's administrative costs are fairly high, constituting between 20 and 25 per cent of the total. While this is partially a reflection of the services that ACPO provides its employees, such as the subsidized cafeteria and chapel facility, it also seems to indicate that ACPO can achieve some cost reductions in this area.

Finally, from the educational output framework, the insight emerges that ACPO does not allocate its funds equally across the outputs, although only relatively small differences exist between the educational output categories. This is interesting since ACPO's decision-makers had assumed that equal time was given to each output. What is not known, however, is the extent to which these output percentages change from one year to the next.

Condensed version of two cost-analysis studies: the Kent Mathematics Project (KMP)[1] and the use of video tapes in a teaching laboratory at the University of Surrey (United Kingdom)

Leslie Gilbert and Jenny Monaco

Introduction

A method for costing educational practice

A handbook published by CET[2] entitled *Costing Educational Practice* by John Fielden and Philip Pearson of Peat, Marwick, Mitchell and Company, sets out a systematic method for costing educational practice. It illustrates how the method may be applied by means of case-studies which analyse the costs of six recent technological innovations in the United Kingdom education and training systems.

The method in question comprises five distinct stages involving:

I. Identification of the practice to be costed.
II. Decision on the approach to be adopted for the cost analysis. (This is achieved by categorization of the practice as one—or more—of five defined types.)
III. Measurement and collection of data.
IV. Data analysis and processing.
V. Presentation of the cost analysis study.

Purpose of the condensed version

Out of the six case-studies, two are presented here. The purpose of this condensed version is to exemplify how each of the first four stages of the cost-analysis method outlined in the handbook was followed in the cost analysis of the project. It is therefore presented in four sections using headings I–IV above. Readers may judge the fifth element—'Presentation'—by referring to the handbook itself.

1. Council for Educational Technology, 3 Devonshire Street, London, 1978.
2. The County of Kent covers 3,700 square kilometres in the south-east of England. It comprises both rural and urban communities.

Kent Mathematics Project

I. Identification of the practice to be costed

1. *Main aims of KMP*
To enable teachers to devise individualized mathematics courses for pupils aged between 9 and 16 in a mixed ability teaching situation and to encourage independent learning with the teacher adopting the role of classroom manager, consultant or adviser.

2. *Description of the project*
KMP is a scheme based on a range of exercises or 'tasks' which have been devised by a special team to suit the needs of pupils of all abilities from the ages of 9 to 16 and covering ten mathematical topics (e.g. number calculating, number structure, plane geometry). The tasks are multi-media and include programmed booklets, audio tapes, games and work-sheets. Teachers select combinations or matrices of these tasks to suit the ability of each individual pupil. In this way, personalized courses are constructed which can cover virtually the whole of a pupil's contact with mathematics during his last eight years of compulsory education. Pupils completing KMP courses may be entered for the Certificate of Secondary Education (CSE) or General Certificate of Education (GCE) at ordinary level.[1] The flexibility of the system allows each course to be tailored to the ability and needs of the pupil who works at his own level in each of the topics.

3. *Development of the Project* (illustrating the state of the innovation at the time of the study and its time-scale)
1962–66, experiments in one school; 1967–70, introduction of the techniques into about ten schools and the beginning of staff and other resource allocations; 1970–73, consolidation under the formal title of 'Kent Mathematics Project'; 1973–77, rapid expansion, with the recruitment of full-time material writers and an increase in the number of schools involved.

The initial development is now complete. Over seventy Kent schools and 27,000 pupils are using KMP. The local education authority (LEA) intends to extend the scheme to the remainder of the locality (thus increasing the number of pupils involved to 35,000) and plans to set up a new operating unit to take over the central running of the system.

4. *Resources involved* (expressed in their primary units)

Staff time. The central KMP team responsible for designing, writing, updating and testing new KMP materials comprises 'professional' staff

1. The CSE and GCE are public United Kingdom examinations normally taken by pupils in their fifth year of secondary school, i.e. at about the age of 16.

who are qualified mathematics teachers, and 'support' staff who provide secretarial and other office services to the professional staff.

(a) *Professional*

Initially there were no special allowances of time to develop KMP. In 1967, the teacher who had conceived the scheme was allowed two days per week. From 1970 onwards the professional staff allocation increased, as reflected in Table 1 which shows professional staff involvement in each year of the project in terms of full-time equivalent staff. It also shows the average number of days per week per person devoted to the project and illustrates a trend towards full-time involvement.

TABLE 1. Professional staff involvement

Year	Professional staff (full-time equivalent)	Average days per week per member
1967/68	0.4	2.0
1968/69	0.4	2.0
1969/70	0.1	0.3
1970/71	1.3	1.7
1971/72	1.7	1.7
1972/73	1.8	3.1
1973/74	3.8	3.2
1974/75	4.2	4.2
1975/76	5.2	4.3

(b) *Support*

Support staff time increased from $7\frac{1}{2}$ hours per week in 1968/69 to nearly 200 hours per week in 1975/76 (see Table 2 for financial cost).

Equipment and materials. KMP is such a large development project that there was not time in this study to itemize the equipment and materials on which expenditure has been incurred, but information is available on the total amounts spent annually (see Table 2). Initially, the expenditure was incurred mainly on equipment and apparatus such as tape recorders, desk calculators and earphones, but gradually a greater proportion had to be spent on printing and tape production. The material was printed offset litho by the LEA, and was delivered to the schools by the LEA's transport.

Accommodation. At first, the accommodation allocation was simply space for a table and a chair but as staff recruitment and stocks of materials increased, the requirement grew to its present level of 88 square metres, divided between two existing teachers' centres (see Table 2 for financial cost).

5. *Qualitative effects of the change*
Qualitative effects of the change were broadly assessed at this stage (see section IV below for details).

6. *Aims of the cost-analysis study*
The analyst approached the task as if he had been commissioned to provide information about the developmental and operating costs of KMP to LEA decision-makers confronted with the choice of whether or not to adopt the scheme.

7. *Basis for comparison*
It was not possible in this study accurately to compare the running costs of the scheme with those of conventional teaching, but there is no evidence that total teacher or student hours are significantly greater or less under KMP than with more traditional methods.

II. Decision on the approach to be adopted for the cost analysis

The approach adopted by the cost analyst was determined by the nature of the project. KMP is characterized by a long development period followed by operational running which involves significant extra quantifiable costs, in order to achieve an outcome which is almost purely educational and which cannot therefore be quantified. It is a major curriculum development scheme which has not aimed to demonstrate cost effectiveness. The CET handbook would categorize it as an 'additional cost, educational benefits project' (i.e. type 4 as exemplified in Chapter 4 of the handbook).

III. Measurement and collection of data

1. *Cost units*
Data on resource effects were all initially collected in terms of their primary units. For example, Table 1 expresses professional staff costs in terms of staff and days per week devoted to the project; Table 2 gives the financial cost of professional staff and of other resources which can be quantified and expressed in financial terms; the out-of-school hours which many teachers have given voluntarily to materials design, testing and updating could not be quantified in the time-scale of this study, and have therefore been excluded.

2. *Life of equipment and materials used in the KMP scheme*
The life of the fully developed system was assessed as being approximately ten years, and that of the educational material (such as cassette-tapes and printed matter) as two years.

3. *Potential for transfer of the system to other LEAs and schools*

KMP is not peculiar to the needs of Kent, and the materials are to be published commercially and made generally available. Until then it is not possible to predict the probable level of take-up by other local education authorities or individual schools.

TABLE 2. Summary of costs (£ at 1976/77 prices)

Year	Professional staff	Support staff	Equipment and supplies	Accommodation	Total
1967/68	2,300	—	400	700	3,400
1968/69	2,400	300	—	1,400	4,100
1969/70	600	400	—	1,400	2,400
1970/71	7,900	1,000	14,700	1,400	25,000
1971/72	10,200	2,000	15,000	2,800	30,000
1972/73	10,900	6,000	15,000	2,800	34,700
1973/74	22,100	8,100	15,000	4,900	50,100
1974/75	24,700	11,400	15,000	6,200	57,300
1975/76	30,100	15,100	15,000	6,200	66,400
1976/77	31,000	13,700	15,000	6,200	65,900
TOTAL	142,200	58,000	105,100	34,000	339,300
Percentage	42	17	31	10	100

IV. Data analysis and processing

1. *Financial costs at school level*

Every school using KMP needs a special room or 'workshop' area in which the materials and equipment can be stored. However, individual school accommodation costs have not been included in this study. Ancillary assistance might have been desirable but has not so far been provided.

The cost of equipping KMP workshops in April 1975 ranged from £220 per workshop for primary schools to £390 for secondary schools. This cost covered: audio equipment, tapes, worksheets and items for games such as pipe cleaners, dominoes and mirrors. The total financial costs of equipment and supplies (see Table 2) are the actual amounts spent adjusted to 1976/77 prices by reference to the general United Kingdom price index.

There is, in effect, no financial cost to the individual school operating the KMP system: the cost of setting up the workshops is at present borne by the LEA; the cost of maintaining them is paid for out of each school's normal 'per capita' allowance[1] and thus represents a substitution for previous expenditure on traditional mathematics books and equipment.

1. Although practice varies from one United Kingdom education authority to another, it is usual for schools to receive block allowances which can be used at their discretion specifically for expenditure on educational materials and small items of equipment. The amount of the allowance is determined by the number and age ranges of the pupils enrolled, hence 'per capita'.

2. *Summary of financial costs incurred by the LEA*

Table 2 shows the financial costs of the project over the past ten years in 1976/77 prices. Increases in the average salaries of professional and support staff during previous years have been allowed for. Accommodation costs of the central team have been based on an imputed annual rental of £70 per square metre which was about the level in 1976 for office space outside London.

No allowance has been made in the figures shown in Table 2 for in-service training or teacher meetings. This is because in-service training is considered a necessary local education authority activity and the KMP in-service training courses have only been partly devoted to KMP. The teacher meetings which have played a vital part in KMP development have also not been costed because they have been seen as part of the intended function of the teachers' centres already established in the LEA. Thus the only staff costs that have been included are the direct ones already described.

The project has received some external funding but this has been ignored in calculating the costs. All resources have therefore been costed as if they were paid for by the LEA.

3. *Summary of quantifiable outcomes*

The outcomes of the project can be quantified in terms of the number of tasks produced, workshops provided and schools and pupils involved. Table 3 shows the growth of these over the last four years of the development for which data were available at the time of the study.

TABLE 3. Growth of the project

Year	Schools	Pupils	Workshops	Tasks
1972/73	63	14,000	120	513
1973/74	63	15,000	194	586
1974/75	65	19,000	211	747
1975/76	71	23,000	273	1,000

4. *Non quantifiable outcomes*

Some perceived educational outcomes of KMP, as revealed by a postal inquiry sent to the participating schools, are:

KMP helps non-specialist mathematics teachers to develop or enhance their general knowledge of mathematics.

KMP helps overcome problems associated with mixed-ability teaching and encourages 'self-discovery' and independent learning.

Children learning with KMP become more involved in plotting their own progress and learning, stimulated by the variety of approaches and media offered by KMP and by the choice of topics studied, better adjusted socially because of the frequent need to work in pairs and in

small groups, and more willing to approach the teacher for advice and guidance when in difficulties. Additionally, poor readers can make progress with the help of the audio-taped tasks.

5. *Steady state costs*
The steady state cost of an innovation expresses in one figure its average annual cost in the long term.

Derivation of steady state cost of KMP. The steady state cost of KMP may be derived from:
(a) The initial development cost which can be taken as the total figure from Table 2 (i.e. roughly £340,000).
(b) The cost of the remaining workshops to be set up in Kent schools which can be estimated, on a *pro rata* basis, from the amount spent so far on equipment and supplies, as being in the region of £30,000.
(c) The operating and continuing development cost which can be taken as that of the proposed central unit, estimated as being £30,000 per annum.
(d) The cost of maintaining the workshops (i.e. replacing equipment and materials) which can probably be ignored for the purposes of this exercise.

Calculation of steady state cost of KMP. Assuming that the project has a ten-year life, the annual steady state cost can now be calculated as follows: development period (one-tenth share), £34,000; remaining workshops (one-tenth of £30,000), £3,000; operating costs, £30,000, or a total annual steady state cost of £67,000.

Comment. This figure probably represents an upper limit to the annual cost of KMP as it takes no account of royalty income from the future publication of the materials (see Section III.3) or the contribution to be made by the proposed new unit to the general development of mathematics in Kent. Both will serve to offset to some extent the central operating costs.

Of this total figure, about £60,000 represents marginal expenditure as the accommodation cost is a notional figure for the use of resources already possessed by the LEA. About half of this £60,000 marginal cost represents a contribution to spending which has already occurred and half represents a future commitment.

6. *Annual cost per pupil*
If the total of £67,000 is spread over for the 35,000 Kent children expected to become involved in the scheme, an annual cost of just under £2 per pupil is obtained.

7. Cost implications to other LEAs who may use KMP
The cost to other LEAs who might use KMP will depend on the prices charged for the published material and on the individual LEA's or school's arrangements for taking over the system.

In Kent it costs about £430 at 1976/77 prices to equip a workshop for a secondary school where it will be used by about 100 pupils, or £4.3 per pupil. If there are no further demands on central funds over an assumed life of ten years, then this implies an average cost to the education authority of around £0.5 per pupil per year. This, however, assumes that the workshops could be set up using commercially available material for roughly the same cost as that incurred in Kent where the LEA used their own production facilities, and is thus likely to be an underestimate.

8. Conclusions
The main conclusions of this study are:

The KMP system is now fully developed and in regular use by about 27,000 schoolchildren.

The main outcomes are of an educational nature and comprise a system which changes the role of the classroom teacher and provides an individual learning course for each pupil.

The system has cost about £340,000 to develop, 90 per cent of which represents marginal expenditure.

The steady state cost averaged over an assumed life of ten years is around £67,000 a year which may be reduced by royalties to be received from the sale of published material.

The annual cost per pupil in the long term, taking Kent's own pupils into account, is likely to be of the order of £2.

The cost to other LEAs could be significantly lower, but this will depend on the prices charged for the published material.

Study of the use of video tapes in a teaching laboratory at the University of Surrey

I. Identification of the project to be costed

1. Main aims of the university video-tape project
To enable each of five different physiology experiments to be demonstrated in one laboratory to five groups of sixteen under-graduate students so that each demonstration can be seen and heard without interruption from the four other demonstrations being given in the laboratory at the same time, and to overcome the problem of short supply of qualified demonstrators.

2. *Description of the project*
A video-tape system is used to give simultaneous practical demonstrations of five different experiments in the physiology laboratory of the Department of Human Biology. Each of the five video-taped experiments is relayed to eight small television monitor screens. (There are forty television monitors in all.) Each television monitor screen is equipped with two sets of headphones to accommodate two students. Therefore up to sixteen students can do one of the five available experiments in any one laboratory period. Prior to each period, a unit of material associated with the experiment to be carried out (written by a lecturer in the department) is distributed. At the beginning of each period, the thirty-minute video-taped demonstrations of the five experiments being offered are given to illustrate the experimental techniques involved and to provide relevant background theory. The students then carry out the experiments themselves under supervision and answer questions in space provided in the written units. These are marked by the staff and contribute to the overall course assessment.

3. *Development of the project* (illustrating the state of the innovation at the time of the study and its time-scale)
1971, the need to demonstrate thirty different experiments per annum to an increasing number of students (about 100), given limited space and a shortage of qualified demonstrators, creates severe problems; video-tape system conceived; 1972–75, installation and trials of video-tape system in a new laboratory; 1975, system fully operational; 1975–77, refinement of system.

The development period is now complete and the system completely integrated into the undergraduate physiology courses.

4. *Resources involved* (expressed in their primary units)
Staff time. Estimates of the time devoted by various categories of staff to the development of the project at the time of the study would form an important element of the subsequent cost analysis. Relevant information collected at this stage is summarized below.

(a) *Academic staff time.* One lecturer wrote separate units to accompany each of thirty different experiments. He also helped make the video tapes. Total time: 450 hours.
(b) *Technical staff time.* Three technicians designed, assembled, tested and installed the system. Total time: 510 man-days. One technician copied each video recording. Total time: 19 man-days.
(c) *Audio-visual aids staff time.* Various specialists, including a producer, cameraman, engineers and graphic design artists, were involved in the production of the video tapes: total time: 66 man-hours for each of 33 tapes = 2,718 hours (i.e. video tapes of thirty experiments, plus three remakes).

Equipment and materials. The system comprises eight 23-cm black-and-white television monitors, each with two sets of head-phones, on each of the five work-benches in the laboratory (i.e. a total of forty television monitors). The five experiments being offered are relayed from separate video-tape decks via a control unit. A written text accompanies each video-taped experiment. A variety of small animals and laboratory instruments is required to enable the students themselves to perform the experiments demonstrated.

Accommodation

(a) A physiology laboratory located in a new building was completed just prior to the decision to develop the video-tape system, but has not been costed in this study.
(b) Use of the television unit of the Audio-visual Aids Department for thirty-three days (i.e. one day per video tape).

5. *Qualitative effects of the change*

The video-tape system was introduced primarily to overcome the organizational and staff problems outlined in Section I (but see Section IV for some perceived educational benefits).

6. *Aims of the cost analysis*

To analyse the costs (and any cost savings) of developing and operating the video-tape system over a total assumed life of twelve years (see Section IV).

7. *Basis for comparison*

The basis for comparison in this study is the situation which existed prior to the introduction of the video-tape system. So far as this study is concerned, the main features prior to reorganization were as follows:

In order to cover the syllabus, five separate experiments had to be demonstrated simultaneously in any one half-day period to almost 100 students. Thus five qualified staff members had to be present for each period and to repeat live demonstrations throughout the year. Staff members also had to help individual students during their experiments and to mark reports written by students after each period. In order to achieve the necessary staff complement, post-graduate students were employed as demonstrators on an hourly basis for each period, but marking students' work could not be done properly in the time for which the post-graduates were paid. Moreover, in some years it was necessary to recruit 'associate lecturers' from outside the department or university, on a part-time basis, because of shortages of post-graduates. The students were often unable to observe the demonstration properly and could be distracted by the occurrence of the four other demonstrations taking place in the laboratory at the same time.

As the preceding paragraphs imply, these problems have been alleviated by the introduction of the video-tape system.

II. Decision on the approach to be adopted for the cost analysis

The approach adopted by the cost analyst was determined by the nature of the video-tape innovation which is characterized by a complex mixture of resource and time effects. It also involves a significant change in the organizational running of the department and in the learning process, both of which make the scheme attractive although their outcome cannot be quantified. The scheme has to justify itself to a large extent in resource terms alone and in order to achieve an estimate of its overall net value it is necessary to combine the effects on the different resources (see Section IV). The CET handbook would categorize it as a 'multi-resource, complex project' (i.e. Type 3 as exemplified in Chapter 4 of the handbook).

III. Measurement and collection of data

1. *Cost units*
Data on resource effects were all initially collected in terms of their primary units. However, as the previous sections have already indicated, some of the resources involved in both the costs and outcomes of this project are quantifiable and those which are measurable are diverse and measured in a variety of units. It was therefore recognized at this stage that a large degree of subjective judgement would need to be exercised in making an overall assessment of the project and this is reflected in the analysis outlined in Section IV.

2. *Life of equipment and materials used in the video-tape system*
The life of the entire system was assessed as being approximately twelve years and that of the educational material (i.e. the video tapes and written units) as being six years, thus allowing for two complete cycles of production during the twelve years.

3. *Potential for transfer of the system to other institutions*
There is considerable scope for the basic idea of the system to be adopted elsewhere but courses in other United Kingdom universities are claimed to be sufficiently different to make the adoption of the course materials extremely unlikely. To date, there has been no more than an occasional exchange of isolated tapes (see Section IV for cost implications to other institutions).

IV. Data analysis and processing

1. *Summary of quantifiable costs* (expressed in primary units)
Given the information already set out in Section I about staff time, equipment and accommodation, given also that each blank video tape

costs £10 and the reprographic costs of the unit texts are £1 per student, the costs of the system expressed in their primary units and spread over an assumed life of twelve years can be calculated and summarized as in Table 1.

TABLE 1. Summary of costs

Period	Equipment (£)	Technician time (man-days)	Academic time (man-days)	AVA staff time (man-days)	Educational materials (£)	AVA studio (days)
1971–77 (years 1–6)	11,230	529	81	310	690	33
1978–83 (years 6–12)	—	15	58	254	930	27
TOTAL	11,230	544	139	564	1,620	60

At the time of the cost-analysis study (1977) the system was half-way through its assumed life. The 1971–77 costs have therefore actually been incurred and 1978–83 are estimates of future costs.

2. *Summary of quantifiable outcomes or savings* (expressed in primary units)
As well as achieving its main aims (see Section I), the project has achieved the following savings: lecturers' and post-graduate demonstrators' preparation and demonstration time has been eliminated; marking time has been reduced from fifteen minutes per student to about five minutes; the department's full-time academic staff and any post-graduate students available can cope with the practical sessions and associate lecturers no longer need to be appointed; because demonstrations are video-taped, the number of animals needed for experiments has been reduced.

Table 2 summarizes these savings over the assumed twelve-year life of the project. For the past, staff and student numbers which actually obtained in each year have been used and for the future very little further growth beyond the 1976–77 position has been assumed. The biggest uncertainty about the future is the supply of post-graduate demonstrators, and the outcome of three situations has been calculated where there are, respectively, zero, one and two demonstrators available in each of the future years. The more demonstrators there are available, the fewer associate lecturers would have been required under the old system and hence the smaller the financial saving from the change-over. Any supply of demonstrators beyond two does not affect the results as, with the 3.5 academic staff assumed to be available, no associate lecturers would be needed.

3. *Summary of quantifiable costs and outcomes combined*
Table 3 shows the results of the next stage of the analysis. Here those resources, both for costs and outcomes, which are measured in the same

TABLE 2. Summary of savings

Period		Saving in staff time by new system (man-hours)		Saving on associate lecturers (£)	Saving on animals (£)
		Lecturers	Demonstrators		
Total to date		1,080	1,130	2,220	1,950
Each future year assuming	0 demonstrators available	440	0	2,220	700
	1 demonstrators available	500	140	740	700
	2+ demonstrators available	470	270	0	700
Total to years 12 assuming	0 demonstrators in years 7–12	3,720	1,130	15,540	6,150
	1 demonstrators in years 7–12	4,080	1,970	6,660	6,150
	2+ demonstrators in years 7–12	3,900	2,750	2,220	6,150

units have been compared. Thus the costs of the equipment and educational materials and the benefits from the saving in associate lecturers and in expenditure on animals, all of which have pounds sterling as their primary units, are combined into one figure. Similarly, the academic staff time spent developing the system is combined with the saving in time achieved from its operation. Other resources are kept separately for the time being.

4. *Financial costs and savings*

The lower half of Table 3 reflects the assumption that, in the next six years, there will be one year when there are no post-graduate demonstrators available; two years when there are two available; and three years with one available. This assumption is obviously subject to error, but is the best estimate of the sort of distribution of the supply of demonstrators that might actually occur.

As an alternative, Table 4 illustrates the financial costs and savings over the life of the project for situations where there are zero and two demonstrators available for every year in the future life of the project. On the basis of this calculation, the analyst's best estimate shows a net gain of around £1,500 and an almost break-even situation in actual cash terms.

All the figures for staff costs are based on 1976–77 wage and salary scales. The cost per day of the television studio has been calculated by writing off the cost of the equipment over six years and assuming that the studio is available for 250 days a year.

5. *Non-quantifiable outcomes*

In addition to achieving its aims, some perceived educational outcomes of the video-tape system are:

TABLE 3. Combination of costs and outcomes

Year	Equipment, materials, associate lecturers, animals (£)	Net academic staff-time (man-days)	Demonstrators' time (man-days)[1]	Technician time (man-days)	AVA staff-time (man-days)	Studio time (studio-days)
1	− 290[2]	− 15	+ 7	− 22	− 28	− 3
2	− 120	− 7	+ 13	− 113	− 47	− 5
3	− 4,280	− 10	+ 43	− 205	− 94	− 10
5	− 3,460	+ 19	+ 44	− 153	− 47	− 5
6	+ 10	+ 29	+ 16	− 33	− 47	− 5
4	+ 390	+ 56	+ 39	− 3	− 47	− 5
Total of years 1–6	− 7,750	+ 72	+ 162	− 529	− 310	− 33
Total of years 7–12 if 0 demonstrators available	+ 16,580	+ 319	0	− 15	− 254	− 27
Total of years 7–12 if 1 demonstrators available	+ 7,700	+ 370	+ 120	− 15	− 254	− 27
Total of years 7–12 if 2 demonstrators available	+ 3,260	+ 345	+ 231	− 15	− 254	− 27
Total of years 1–12 if 0 demonstrators available in years 7–12	+ 8,830	+ 391	+ 162	− 619	− 564	− 60
Total of years 1–12 if 1 demonstrators available in years 7–12	− 50	+ 442	+ 282	− 619	− 564	− 60
Total of years 1–12 if 2 demonstrators available in years 7–12	− 4,490	+ 417	+ 393	− 619	− 564	− 60

1. Demonstrators' man-hours have been converted to man-days by assuming a hypothetical week of thirty-five hours.
2. A negative sign indicates a net cost and a positive one a net gain.

Table 4. Summary of results

Assumption on years 7–12	Resources with £ as their primary unit	Other resources expressed in £ units	Total in £ units
No demonstrators[1]	+ 8,830	− 1,920	+ 6,910
Best estimate	− 50	+ 1,580	+ 1,530
Two demonstrators	− 4,490	+ 3,140	− 1,350

1. A negative sign indicates a net cost and a positive one a net gain.

That the equipment can be used for showing films made by commercial organizations or other institutions; or, in conjunction with a television camera, it can be used to show live experiments to larger audiences than would otherwise be possible.

Although by no means without criticism, students are undoubtedly in favour of the new system and it seems reasonable to make the conservative assumption that, educationally, the change-over leaves the department at least as well off as before.

6. *Discounting the cash flows*

In general, financial resources are worth more now than at some time in the future. The most common way of attempting to take account of this in project evaluation is to discount the series of cash flows to their value at the start of the project, using some notional discount rate. This has the effect of reducing future cash flows to a 'present value' such that if it were invested at the notional rate it would exactly equal the amount of the future cash flow after the appropriate period. This method has been used to amend the series of costs and savings which have money as their primary unit using a normal United Kingdom discount rate of 10 per cent per annum.

The results are shown in Table 5. This has the same format as Table 4 but the resources measured directly in monetary units have been discounted to their value at year 1.

Table 5. Summary of results when discounted

Assumption on years 7–12	Resources with £ as their primary unit, discounted to their value at year 1	Other resources (not discounted) expressed in £ units	Total in £ units
No demonstrators	+ 1,200	− 1,920	− 720
Best estimate	− 2,810	+ 1,580	− 1,230
Two demonstrators	− 4,810	+ 3,140	− 1,670

The effects of discounting the cash flows are: firstly, that the project appears less attractive because most of the costs arise early in its life while most of the benefits accrue later; and, secondly, that the sensitivity of the overall result with respect to the supply of demonstrators is greatly reduced.

7. *Cost implications to other institutions which may wish to adopt the video-tape scheme*

The cost of adopting this scheme could be much greater to other institutions than in the application studied here for the following reasons:

Few other similar departments have such large numbers of undergraduates attending practical sessions.

The development has so far cost the lecturer concerned about a year of his personal research time. However, in any future applications it may be necessary to relieve staff of their teaching duties or to recruit outside help.

The department had access to a television unit of high professional standard and with spare capacity. An institution without these facilities would find a similar project expensive to introduce.

8. *Conclusions*

The main conclusions from the cost analysis are:

The project has achieved its main objectives.

The project required an outlay of about £12,000 in cash with considerable manpower resources amounting to about six man-years of effort.

Allowing for discounting the cash savings, it is estimated that about 80 per cent of the cash outlay will be recouped over the life of the project. This could, however, lie between a net outlay of about £4,800 and a net gain of £1,200.

The value in monetary units of the other resources used will probably be more than offset by the benefits in the savings of staff time.

Overall, in monetary units, the project will probably about break even over its life.

Because the innovation has used resources which were relatively freely available in order to relieve the hard-pressed resource of academic staff time, it is in real terms more cost-effective than it appears from a simple calculation in financial terms, but this cannot be gauged quantitatively.

In addition to the quantitative effects there are other changes which on the whole are certainly beneficial.

The decision to go ahead with the development therefore seems to have been the right one in the particular institution and at the particular time concerned.

There is scope for transfer of the idea rather than the detailed material, but similar development elsewhere might be more expensive that in the system studied.

Socio-economic analysis of two systems of educational television in Brazil in the states of Maranhão and Ceará[1]

J. B. Oliveira and F. Orivel

Introduction

For an economist, the outstanding feature of an educational system centred on the use of television is that fixed costs are higher than in systems employing traditional methods.

Is this extra cost counterbalanced by gains elsewhere? In theory, there are two main potential 'benefits'. The first is lower labour costs since the teacher is no longer the only purveyor of knowledge. He is, in fact, less important than the television set and therefore, in theory, needs to be less qualified than before and hence less well paid.

The other advantage expected is related to the quality of teaching. The combination of two media (teacher and television), often supplemented by a third (written materials), should produce significantly better educational standards.

These two benefits, which the economist is seeking to identify, do not necessarily reflect the objectives of most known experiments. The background to each project reveals that decision-making processes have been complex, that certain individuals have played a dominant role and that the underlying arguments vary greatly according to the particular situation.

A glance at the past suggests that enthusiasm for the new media, strong in the 1960s, has been tending to subside since the mid-1970s. It is significant that, in the 1960s, three specialist groups—'lobbies', even—dominated the planning and implementation of these educational experiments: educationists attracted by the possibilities of the new media, manufacturers wanting to sell their new products, and specialists in the use of the equipment together with 'politicians' or final decision-makers. Only recently did economists begin to take an interest in the new educational technologies, when decision-makers became somewhat confusedly aware that the cost-effectiveness of their experiments was not as advantageous as expected and wanted more precise accounts founded on observed data rather than on forecasts.

It is not always self-evident that education by television is more

1. The information on Maranhão is drawn from a 1976 study made by the authors in conjunction with E. Arena and D. Jamison.

cost-effective than the traditional approach, and in addition there is a world-wide trend to hold back the growth of resources allocated to education. The world average today is 5.1 per cent of GNP. The elasticity of public expenditure on education, 2 between 1960 and 1965 and 1.5 between 1965 and 1970, dropped to 1 between 1970 and 1974.[1] It is thus unlikely that the 5 per cent average will go up much, though country-to-country variations might be slightly reduced. Brazil, which is well below the world average, will perhaps tend to draw closer.

The challenge thus facing those in charge of education is to do better with resources that are going to stay the same.

Recourse to technologies based on industrially manufactured media, that is, technologies with a falling cost structure, seems *a priori* to offer a possible solution. In the technology of providing goods and services, education is a curious exception to the general rule in that labour plays a dominant role and capital a very small one. Indeed, it may be wondered whether the tendency for capital costs to decrease will ever apply to the education sector. At all events, there are two reasons why education has so far been unaffected by industrial-type technologies. First, its production costs are not charged to the ultimate authority, i.e. employers, but are usually borne by tax-payers and families. Tax-payers have been led to believe in the 'higher good' and families to believe that human capital is profitable whatever the cost. Second, the teaching profession and educationists tend to place a very high value on the human relationship (and, in so doing, to defend their jobs) and jib at the use of 'machines'.

The two Brazilian experiments examined here have similar backgrounds: the problems of providing an education of a high standard in certain geographical areas or social milieux where qualified teachers are lacking have led to a desire to find in television an alternative to underqualified schoolteachers, the higher costs of television being offset by lower teacher costs and better education.

This report shows that these goals have been only partially attained.

I *Background*

General economic situation in Brazil

In the last fifteen years, Brazil's gross national product (GNP) has grown at a very high average rate (6.9 per cent), largely due to the volume of foreign and public capital investment.

Like a few other developing countries, such as Singapore, the Republic of Korea and Mexico, Brazil spent this period moving towards

1. See J. C. Eicher and F. Orivel, *L'Allocation des Ressources à l'Éducation dans le Monde, 1960-1974*, Paris, Unesco, 1979.

a modern and sophisticated industrial economy and is likely to become, within the next few decades, a major economic power with a particularly well-developed public sector. The country also possesses large stocks of natural resources, some of which are of great strategic importance.

The net inflow of foreign capital is still regarded as a vital means for solving short- and long-term difficulties as regards the balance of payments and for financing the investments on which future growth depends.

The public authorities are taking more and more economic initiatives to counterbalance the influence of the multinational corporations and make up for the weakness of private initiative at home. The State is concentrating its expenditure on infrastructures or social measures and on stimulating investments (by measures to guarantee demand and by long-term loans). There is, however, not much room for manoeuvre, partly because the government cannot call upon foreign suppliers as much as it would like and partly because it has to contend with severe international competition in the economic activities it is seeking to develop. At the same time there are pressing needs within Brazil that must also be taken into consideration.

TABLE 1. Evolution of overall GNP and per capita GNP

	GNP in millions of U.S.$	Population[1]	Per capita GNP in U.S.$
1970	41,776	92,343,000	452
1971	49,338	94,927,576	519
1972	58,466	97,585,548	599
1973	77,236	100,317,900	769
1975	106,666	107,000,000	1,010
1976	116,052	109,996,000	1,099

1. Estimated by applying a growth rate of 2.8 per cent to the 1970 census.
Source: Estatísticas da Educação Nacional, MEC/S6/SEEC. World Bank.

The country is faced with two formidable problems: the permanent disequilibrium in the balance of payments and a very high rate of inflation. These are due not only to inadequacies in the economic policy being followed but also to the nature and forms of the capital employed and to an unbalanced economic structure. Furthermore, the Brazilian economy's growing dependence on foreign capital submits decisions on internal economic policy to the dictates of multinational companies. These difficulties lead to frequent and considerable changes in the exchange rate, the cruzeiro having lost three-quarters of its value in relation to the U.S. dollar between 1969 and 1978. In the two years from 1976 to 1978, the general price index exactly doubled.

To complete this brief review of Brazil's economic situation, it must be stressed that the average per capita GNP, over $1,000 in 1976,

TABLE 2. Rate of inflation in Brazil

Year	Rate of inflation (%)	Deflator	Conversion factor to obtain 1978 cruzeiros
1969	22.3	13	7.70
1970	19.8	15	6.46
1971	20.4	19	5.26
1972	17.0	22	4.44
1973	15.1	26	3.78
1974	28.7	30	3.28
1975	27.7	39	2.56
1976	49.0	50	2.00
1977	41.0	71	1.41
1978	—	100	1.00

TABLE 3. Evolution of cruzeiro in relation to U.S. dollar

Year and month	Cruzeiros per dollar	Year and month	Cruzeiros per dollar
1969	4.076	1974 July	6.845
1970	4.92	1975 January	7.51
1971	5.60	1975 July	8.23
1973	6.18	1976 December	11.76
1974 January	6.30	1978 February	16.45

conceals the fact that incomes are extremely unequally distributed since the top 20 per cent of the population account for 60 per cent of total incomes and the bottom 20 per cent no more than 1.5 per cent.

Economic situation in the state of Maranhão

Maranhão is one of the twenty-two states of the Federative Republic of Brazil. Its area, much the same as that of Italy or the Federal Republic of Germany, is a little over 300,000 square kilometres but, with only 3 million inhabitants, the population density is a mere 10 per square kilometre.

Maranhão is situated between the dry regions of the north-east (the celebrated Sertão) and the immense humid plain of the Amazon. Its capital, São Luís, borders the Atlantic, only a few degrees south of the equator.

It is one of the poorest states of Brazil. Its main resources are related to agriculture and go mostly for local consumption. The main food crops are rice, manioc, millet and beans; sugar-cane and oil palms are grown industrially. Stock raising and fishing are essentially for local needs.

As in Brazil as a whole, the population of Maranhão is expanding

rapidly, by about 2.8 per cent a year. In 1940 there were only 1.2 million inhabitants but in 1975 over 3 million. The result is a very young population and therefore relatively few workers.

The most recent census (1970) classified the working population as follows: primary sector, 762,900 or 78.4 per cent; secondary sector, 49,184 or 5 per cent; tertiary sector, 161,076 or 16.6 per cent, totalling 973,160.

These figures indicate that less than a third (32.5 per cent) of Maranhão's population is active and that more than three-quarters depend on subsistence farming.

It is difficult to provide accurate GNP figures for Maranhão. In 1969, official documents put the per capita GNP at $78.4 and it is very unlikely to have exceeded $200, or a mere one-fifth of the national average in 1978.

As with Brazil in general, income is very unequally distributed. Here again there exist no statistics, but a few indicators will serve. In November 1976, the minimum legal wage was 544 cruzeiros a month or, at the official rate of exchange, $46, but a wide variety of sources suggest that many wage earners receive far less. Municipal primary teachers, for example, are paid less than half of this sum and an idea of their purchasing power can be gathered from the fact that a basic food such as beans then cost 20 cruzeiros a kilo, a meal in a restaurant 50 and a pair of sandals 100. At the other end of the scale, the wealthy classes enjoy roughly the same income as their counterparts in Western countries and a distinctly greater purchasing power, since the cost of services is low and fringe benefits are more common (chauffeur-driven car, servants, etc.).

The public authorities (state and communes) administer small budgets which make it impossible to provide social services (such as education) of a high standard. The existence of a wealthy class explains the growth of a network of fee-paying private schools and the still very inadequate coverage of public education.

Economic situation in the state of Ceará

In 1977, Ceará had 5.3 million inhabitants in an area of 146,817 kilometres (36 inhabitants per square kilometre). The population is young and growing at over 2 per cent a year. The chief economic resources are agricultural—cattle-raising, beans, cotton—and industrial development is still on a small scale, almost entirely concentrated on light industries (textiles, foodstuffs), with a small chemical sector.

The towns and cities have grown very quickly over the last twenty years. Fortaleza, the capital, now has over 1 million inhabitants while four other cities have more than 100,000 and seven between 50,000 and 100,000.

Population movements occur on a large scale, in several stages, from the villages to small towns, from small towns to medium-sized towns,

from the latter to the capital, and from Fortaleza towards the more developed states of Brazil.

The working population is small, numbering only 1.4 million out of 5.3 million (26.4 per cent) in 1974: 60 per cent work in agriculture, 13 per cent in industry and 27 per cent in services. Services alone account for 57 per cent of the added value, mainly at the expense of agriculture (only 30 per cent) and a little at the expense of industry (12 per cent).

The 1977 per capita GNP can be estimated at about $250 a year, or a quarter of Brazil's national average. Even though Ceará has developed quite quickly in recent years it is still a poor state with many problems of infrastructure, public services and employment to solve. On the whole, the economic conditions in Ceará are fairly similar to those observed in Maranhão.

General organization of education in Brazil

There are three levels of education in Brazil. Basic schooling, known as the first *grau*, lasts eight years (first to eighth years), followed by three years of secondary education (second *grau*) and higher education.

In theory, responsibility for education is shared between the communes, whose job is to run the first four years of basic schooling, the states, which look after the next four years and the three or four years of secondary education, and the federal government, which deals with the universities.

In practice each tends to overlap the others. The communes usually find it very difficult to meet their obligations and the states often take over some of them and also, in some cases, finance universities. The federal government often encroaches on the state's sphere, and there exist many unsubsidized private schools, particularly for the fifth year onwards.

The states receive subsidies from the federal government. These subsidies are directly linked to the number of inhabitants and the efforts made by the states themselves and are in inverse proportion to per capita income. The latter provision has a powerful impact because there are very great differences between states in the average income per person.

The states are not entirely independent. They must comply with federal laws on education which, among other things, provide for a uniform basic organization.

This model, however, is applied to a varying extent in the states, and it is fair to say that the network of schools in all states with a per capita income less than the national average is still rudimentary, particularly in the rural areas of central and northern Brazil, which retain their importance in spite of the rapid growth of towns.

The outstanding feature of these regions is the very high drop-out rate from one year to the next. The rate, in fact, is so high from the very first years of primary education that only about 10 per cent of pupils reach the secondary level.

Another feature of the rural regions—also true for southern Brazil—is their inability to attract the qualified teachers they need. The fact is that, from the fifth year onwards, teachers are subject-teachers and must, in theory, hold a university-level qualification. These people are very difficult to keep in rural areas since, in a country as enormous as Brazil, they are all but completely cut off.

The result is that the few schools which do teach the fifth to eighth years usually have low standards, and this produces an educational pyramid with a broad base and very narrow top.

TABLE 4. Educational pyramid in Brazil

Level	Class	Year	Enrolments: first year = 1,000
University		1974	70
Secondary education	3	1973	75
	2	1972	87
	1	1971	107
Basic schooling	8	1970	101
	7	1969	115
	6	1968	133
	5	1967	165
	4	1966	245
	3	1965	318
	2	1964	449
	1	1963	1,000

Source: Estatísticas da Educação Nacional 1971–73, MEC/SEEC, p. 29.

This pyramid shows what chances a pupil starting school in 1963 had of acceding to the different levels of the system. Those chances are a little better today although there is still a long way to go before the theoretically compulsory 100 per cent enrolment rate for all eight years of basic education is attained.

In 1974 there were 19,286,611 pupils in basic schools, distributed as follows: 18.3 per cent of all basic school enrolments are repeaters. The first year alone accounts for 30 per cent of the pupils whereas, with a constant enrolment rate throughout the eight years, it should be only 12.5 per cent. Though enrolment is almost total in the first year, it drops to 60 per cent in the second year, to 50 per cent in the third and less than 20 per cent in the eighth year, the general average being under 45 per cent, or 62 per cent for the first four years and 26 per cent for the other four.

By type of school, state schools take 57 per cent of pupils, municipal schools 30 per cent, private schools 12 per cent and federal schools under 1 per cent. As for standards, the private schools, attended by children of

TABLE 5. Children at school in 1974

Year	New entrants	Repeaters	Total
8	821,674	49,328	871,002
7	1,045,590	98,598	1,144,189
6	1,279,451	154,686	1,434,137
5	1,609,825	218,066	1,827,891
4	1,899,416	204,440	2,103,856
3	2,266,421	266,649	2,533,070
2	2,620,923	523,697	3,144,620
1	4,290,788	1,411,282	5,702,070
Year of enrolment unknown	468,374	57,402	525,776
TOTAL	16,302,462	2,984,149	19,286,611

the rich, have the highest reputation, followed by the state schools. The municipal schools are regarded as very mediocre.

The shortcomings of the formal education system have led the Brazilian authorities to organize non-formal remedial systems known as '*suppletivo*': (a) the Mobral is an adult literacy campaign which, in a few years, has involved nearly 10 million people; (b) a very large number of institutions exist to give a second chance to those unable to attend school at the normal age: continuous training for primary teachers, agricultural training, technical and vocational training, diplomas (*madureza*) equivalent to the first and second levels. These institutions come under either the federal government or the states.

It should be pointed out that most educational courses using radio and television come into this category, though the school television projects of Maranhão and Ceará are part of the formal system.

To conclude this summary of the general organization of education in Brazil, it should be noted that the school year begins on 15 March and ends at Christmas, thus coinciding with the civil year and avoiding many headaches for the statistician. Furthermore, the school day is, in fact, only a half-day of 4 hours; with 5 days a week of school (i.e. 20 hours) and 180 days a year (720 hours), Brazilian schools function for 25 per cent less time than, for example, French ones. This system has two important consequences. In the first place, classrooms can be used for two separate classes, one in the morning and the other in the afternoon, a possibility which economists would recognize as a particularly efficient allocation of resources. Secondly, the teachers, who are occupied for four hours every morning, have the time to take up a second job in the afternoons, and it appears that many of them do so.

Education in the state of Maranhão

The education system of Maranhão, like that of Ceará, reflects in a concentrated form the shortcomings and omissions of the Brazilian system in general.

Table 6 sets out the growth in basic school enrolments (first to eighth years) from 1971 to 1976. The schools are grouped according to who finances them: the federal government, the states, the communes or families (private schools). The communes play a very important part, with just over half the total school population. Their schools, mainly for the first four years, are of a very low standard, with minimal resources.

The state of Maranhão finances about a third of total enrolments. Its schools usually cover the full eight-year course but, of 205,000 pupils in their charge, 168,300 are in the first four classes and only 36,700 in the fifth to eighth years.

Inasmuch as the figures for private and federal schools concern almost exclusively pupils in the fifth to eighth years, there is no doubt that the state of Maranhão has enormous difficulty in meeting its legal obligation to provide schooling for the fifth to eighth years. The fact is that about 350,000 children should be studying at this level but the state schools actually cater for only 36,000, or about 10 per cent.

TABLE 6. State of Maranhão: enrolments in basic education, by financing authority

Year	7–14 year population[1]	Enrolments				Total	Enrolment rate[2]
		Federal schools	State schools	Commune schools	Private schools		
1971	682,970	4,124	107,523	241,380	56,019	409,046	59.9
1972	698,662	5,135	123,413	260,963	64,633	454,144	65.0
1973	715,162	4,278	140,617	263,173	79,422	487,490	68.2
1974	732,295	4,198	160,219	280,403	81,123	525,943	71.8
1975[2]	750,227	4,846	182,649	293,410	82,284	563,719	75.1
1976	768,823	5,495	205,079	306,417	84,525	601,516	78.2

1. Estimated.
2. The actual rates are rather lower because total enrolments include children under 7 (about 5 per cent) and over 14 (about 15 per cent).

Source: MEC/VEI/ATEC/SE.

Between 1971 and 1976, the average enrolment rate rose from 60 per cent to 78 per cent but, allowing for the fact that 5 per cent of pupils are under 7 and 15 per cent over 14, the true average rate in 1976 for the 7–14 age group was only about 60 per cent.

The quality of education in the state of Maranhão reflects, in an even more exaggerated fashion, the already-mentioned pyramid. Taking

TABLE 7. State of Maranhão: fifth to eighth year enrolments in 1976[1]

	Fifth		Sixth		Seventh		Eighth		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
FMTV[2]	4,448	34.3	3,413	33.9	2,992	36.8	2,169	39.2	13,022	35.4
Other schools	8,509	65.7	6,664	66.1	5,142	63.2	3,404	60.8	23,719	64.6
TOTAL	12,957	100	10,077	100	8,134	100	5,573	100	36,741	100

1. No data is available on 1976 enrolments in private schools. In 1973, however, they accounted for about 60 per cent of total enrolments for the fifth to eighth years and there is no evidence to suggest that this proportion fell between 1973 and 1976.
2. The Fundação Maranhense de Televisão Educativa (The Maranhão Foundation for Educational Television), the system examined in this report.

the cohort starting school in 1962, of 100 pupils aged 7 in the first year thirty-seven entered the second year, ten the fifth year, seven secondary education and two university (in 1974) (it is assumed that there would be about the same number of repeaters as in the age groups immediately before). The situation has slightly improved with time. An estimated 25 per cent of pupils (including those in private schools) now enter the fifth year, but it must not be forgotten that there is a wide gap between São Luís, the capital, and the rest of the state, which is still in much the same situation as the age group already referred to.

This is probably due, among other things, to the very low average living standards of the population—some of the lowest in South America—the fact that there is a long way to go to school, poor teaching, inadequately trained teachers with low salaries, not even a basic minimum of teaching materials and, in general, serious administrative shortcomings in regard to finance, management and staffing.

Education in the state of Ceará

Ceará, of course, displays similar features, with a very large number of pupils dropping out from one year to the next.

The apparent enrolment rate, as Table 8 indicates, is improving (from 54 per cent in 1970 to 72 per cent in 1975) for the eight years of basic education. In point of fact, however, nearly 200,000 of the 785,000 enrolments in 1975 were over 14 or under 7 years old, with the result that the actual number of children in the 7–14 age group attending school was only 585,000 or 55 per cent. This rate, moreover, is simply an average and the pyramid effect means that it is quite a lot higher in the first years and much lower towards the last years; that is, the years covered by the school television system with which we are concerned. There are also notable differences between those living in towns (apparent enrolment rate over 90 per cent) and country dwellers (under 50 per cent).

TABLE 8. State of Ceará: enrolment rates in basic and secondary schools

Year	Basic schools			Secondary schools		
	Enrolments	7–14 year population	Enrolment rate	Enrolments	15–19 year population	Enrolment rate
1970	511,930	943,319	54.3	27,962	475,545	5.9
1971	550,388	968,533	56.8	31,154	488,750	6.4
1972	653,566	995,839	65.6	36,838	502,530	7.3
1973	705,612	1,024,062	69.0	38,354	516,772	7.4
1974	776,402	1,053,235	73.7	45,467	531,494	8.6
1975	784,900	1,083,398	72.4	52,895	546,715	9.7

Source: SEES/MEC, 1976.

Municipal schools, the least well off, provide for 52 per cent of pupils; state schools for 26 per cent, these schools being slightly better off but mainly in the towns; and the private schools, accessible only to the more wealthy classes, for 22 per cent.

There are two main reasons for the high drop-out rate: the standards in many schools are low, and many municipal schools only cover the early classes, most of them stopping at the fifth, sixth or seventh year.

The teachers are not properly qualified. There were 32,313 working in basic schools in 1975, of whom 14,432 (almost half) had not completed their schooling: 11,406 had received secondary education and 4,820 had had a higher education. The repetition rate, nearly 20 per cent in the first four years, falls to 2.5–4 per cent in the last four. The large number of drop-outs and repeaters may be illustrated by the fact that only 35,778 out of 228,291 pupils enrolled in the first year in 1970 reached the sixth year in 1975, the greatest losses occurring at the end of the first year. The state authorities have worked out cautious forecasts for up to 1983 which show a slightly improved enrolment rate but at a pace which will not make it possible to arrive at an apparent total enrolment until 1990.

The chief conclusion to be drawn from this evidence would seem to be that the weak point of the Maranhão and Ceará education systems is the second half of basic education, especially in rural areas where classes are few and what teachers there are, very underqualified. The school television projects have been launched there as a large-scale answer to this problem and the purpose of this report is, in fact, to determine how far this decision is providing a satisfactory solution.

II *Two systems of education by television*

It is particularly interesting to compare the systems of school television in Maranhão and Ceará as both are essentially aimed at the second part of basic education, that is, at pupils from the fifth to eighth year.

The Maranhão system emerges as an independent, centralized scheme in which the medium of television is an integral part of a new approach to teaching, focused on development.

The Ceará project, on the other hand, is part of the present education system. It is decentralized and the television programmes are designed to assist or support teachers who volunteer to take part. In Maranhão, the infrastructures limit television coverage to the capital and its suburbs, but in Ceará it extends to rural areas too.

School television in Maranhão

Goals

When the Maranhão authorities took the decision, towards the end of the 1960s, to set up a system of school television, their goal was to meet the educational needs of the State. The first step was to develop the public education system by providing an educational service at the level of the second half of basic schooling for children who did not have access to that schooling.

The main target audience is the children of poor people in the suburbs of the capital who cannot afford private school fees. These underfed youngsters, with little interest in learning and unable to see the point in education but anxious to receive practical instruction, are well aware of the reality within which they will have to make their way.

This situation also explains the second goal, which is to renew curricula and teaching methods in order to provide the State with the skilled labour necessary for development.

Institutional structure

The Fundação Maranhense de Televisão Educativa (FMTVE) set up in 1969 to organize the new system, is an independent institution coming directly under Maranhão's Secretary of State for Education, who is its president. It has the powers of a school system in its own right and is responsible for providing the last four years (fifth to eighth) of basic schooling. The schools and classes come under the sole authority of the FMTVE which opens new ones when necessary and appoints the teaching staff. The course is free but the other (private) schools do not have access to school television.

Development of the system

In early 1969, thirty-five fifth-year trial classes, with an average of thirty-five pupils in each, were taught by closed-circuit television. By 1970 a transmitter had been brought into service to extend the system's coverage. Table 9 shows how the number of new enrolments and classes has grown. The first group finished the course in 1972. The system is highly concentrated since there are schools with twenty classes of forty to fifty pupils in each. Since 1972, total numbers have remained fairly steady, with pupils

concentrated in the São Luís region. The most distant school in 1978 was sixty kilometres away. Further expansion, and hence more schooling for rural areas, depends on broader television coverage. The FMTVE is aiming for 25,000 pupils in 1981 and 35,000 in 1985.

TABLE 9. FMTVE: New classes and enrolments by year, 1969–78

Year	Number of schools	Number of classes	Fifth year	Sixth year	Seventh year	Eighth year	Total
1969	15	35	1,255	—	—	—	1,255
1970	9[1]	152	4,516	1,735[2]	—	—	6.251
1971	9	199	3,512	4,191	1,712	—	9,415
1972	9	265	3,691	3,433	3,859	1,636	12,619
1973	10	300	2,936	3,443	3,131	3,401	12,911
1974	10	272	3,614	2,723	3,099	2,688	12,124
1975	10	286	4,192	3,160	2,681	2,446	12,479
1976	13	315	4,448	3,413	2,992	2,169	13,022
1977	14	315	nd	nd	nd	nd	13,407
1978	15	318	nd	nd	nd	nd	15,004

1. Schools were re-grouped in 1970. Each school consists of a number of classes of which most but not necessarily all are in the same place.
2. This figure is higher than 1969 fifth-year pupil numbers because of the relatively numerous cases of direct access when the system came into operation.

Source: FMTVE-CEPI.

The organization of teaching

The FMTVE's approach to teaching starts from the principle that the pupil is an active agent of the educational process, education being regarded in its broadest sense as an action conducive to changes in the pupil's attitude and the development of all aspects of his personality. These principles are put into practice through: problem-based learning, a syllabus broken down into small pluri-disciplinary units; abolition of the class system—work is not based on the class but on small groups of six to seven pupils within the class. Teaching is based on group dynamics, learning and teaching within the group and mutual instruction. The teachers, known as 'counsellors', play a key role in stimulating the small groups that make up the class; a process of continuous assessment by regular tests to gauge what has been understood and assimilated so that support teaching may be immediately arranged whenever necessary; a very large measure of individual or group initiative.

Teaching proceeds in four stages:

1. A subject is introduced by the television programme.
2. Individual or group exploration aimed at developing the sense of analysis and criticism.
3. An individual reply or general discussion to complete the process of assimilation.
4. Assessment of individual or group work and final summary.

How the classes function

Each lesson begins with a television broadcast of about twenty minutes, which usually ends with a question, or 'challenge', which has to be considered and dealt with by pupils, working in groups of six or seven in classes averaging forty-five. The chief task of the 'counsellor' is to encourage his pupils to carry out the activities suggested by each programme. The pupils can refer to written materials prepared and distributed by the centre, and they are provided with the materials needed for experiments or various other class activities. Once a month, each group elects a spokesman and a leader, who are in charge of internal discipline and have to see that the various stages of the teaching process are carried out. Individual or group findings are presented and discussed by the spokesmen and the leaders may question pupils in other groups. The counsellors usually intervene very little and it is by no means uncommon to see classes functioning normally when the counsellor is not there.

Class work, however, is only part of the educational process. There are many other activities, such as clubs (literature, the arts, games, politics) and all kinds of practical handicrafts.

Saturdays are often set aside for general revision, meetings between the counsellor and pupils, or big inter-school get-togethers or celebrations.

Assessment

Marking and assessment is based on three factors: (a) the actual work done by pupils in each subject (15 per cent of the overall mark); (b) individual practical exercises (25 per cent) ; (c) general tests produced by the team that plan the courses (60 per cent of the monthly mark in each subject). Apart from showing the pupil's intellectual ability, these tests are designed to reveal his ability to think and analyse, his sense of synthesis, his interest in the subject, and so forth.

Teaching staff

This approach to education has given the teaching staff a new role and function.

The classes are run by 'counsellors'. These people are non-specialist educators whose work is backed up by educational advisers or 'supervisors', the latter being teachers specializing in the basic subjects taught. Unlike ordinary schools, there is no headmaster or director but one or two 'supervisors' to see that classes function smoothly.

At the beginning of each year, a fortnight's training-course is arranged for 'counsellors'. All counsellors are sent a handbook which explains the general thinking behind the system and how it operates.

In 1976, FMTVE employed 850 persons of whom 570 (67 per cent) were in the schools. Thus for 315 classes, there were 470 counsellors (including those on leave) and 30 supervisors (1 for 10 classes), giving 1.58 teaching staff per class of 45 pupils, plus 70 service personnel.

Organization of production and broadcasting

Teams of specialists in curriculum development, the production of television programmes and written materials prepare what is needed for the system at the São Luís centre. The relationship between these teams has varied over the years but the views of educationists have, on the whole, always prevailed. The production division is in charge of programmes from the initial idea to final evaluation but, for a number of reasons, the task of production itself has tended to receive more attention than inquiry, analysis and self-criticism.

Until 1974, the lack of tapes left the teams with the enormous task of reproducing all the broadcasts each year. These difficulties have now been overcome and many programmes are stored for rebroadcasting the following year, with the result that production has been stabilized at its 1976 level (see Table 10). At first, most of the programmes simply placed a teacher in front of the camera. Today more and more film excerpts, illustrative photographs or drawings and brief printed messages are included. Each programme must focus on a specific objective.

TABLE 10. Number of television programmes produced[1]

	1969	1970	1971	1972	1973	1974	1975
Programmes produced and broadcast	763	1,159	1,714	1,901	2,063	2,210	1,229
Programmes recorded for later use	—	—	—	—	554	508	1,174

1. The average length of a programme is twenty minutes.
Source: FMTVE/Curriculum co-ordination.

The broadcasts are directed at the fifth- and eighth-year pupils in the morning and at the sixth- and seventh-year pupils in the afternoons, the same classrooms being used twice a day.

The centre also produces written materials for the pupils in the form of six textbooks of about 200 pages for each level. These textbooks are revised annually.

FMTVE has its own production and broadcasting facilities. It has set up two studios, administrative offices and offices for the educational staff installed in makeshift premises. It has its own transmitter (2 Kw), and produces on two inches and one inch (Ampex equipment). It also runs a maintenance unit and workshops for repairing the equipment of the centre and the schools. There is also a print shop for the written materials and a drawing office that provides illustrations for those materials as well as contributing to the television programmes. Lastly, FMTVE organizes the distribution of its own documents. In 1975, the production centre employed 280 persons, or 33 per cent of the total FMTVE staff.

Feedback and control
FMTVE keeps in touch with the supervisors through the centre's educational co-ordination service, which arranges monthly meetings. It is not at all uncommon for the educational director to join them.

The supervisors are the link between the classroom 'counsellors' and the centre. They meet the counsellors regularly each week to discuss the past week's work and plans for the next. The counsellors have a great deal to do in as much as they must mark what has been taught and report on the problems of individual pupils, lesson plans and test results. This information is written down on special forms, picked up by the supervisors and collected for statistical purposes by the education co-ordination service.

Educational television in the state of Ceará

Objectives
When the Ceará authorities decided, in the early 1970s, to set up a system of educational television, the most important objective they assigned to it was to improve the quality of education in the second half of basic schooling and to facilitate the opening of new schools within the state. The next target was to serve other sectors, especially adult education and courses for the backward and, lastly, to provide general information and foster cultural activity.

Institutional framework
The decision to create the educational television of Ceará (TVE) was taken in 1973 by the state secretariat for education. A new institution, the Fundação Educacional do Estado do Ceará (FUNEDUCE), which also administers the state university, was set up. Within the FUNEDUCE, which is directly under the authority of the secretary of state for education, TVE is run by an executive director with the assistance of four technical directors. Its budget is incorporated in that of FUNEDUCE and apart from increases to compensate for inflation, has remained constant.

The task of TVE is to produce programmes and supporting documents and to train teachers and educational advisers. It does not administer schools or their staff. This is because reception is fully decentralized and TVE signs association agreements with both municipal and private schools. It can even happen that only one class of a particular school follows the television course. Participation is in fact on a voluntary basis. All that is needed is a teacher prepared to go on a course of training, a classroom and a television set, and a willingness to accept TVE's guidance on educational matters.

The development of the system
Under these conditions the system developed very quickly, the only limitation being the extent of the coverage provided by the television network.

TVE was established in 1973 and started broadcasting for fifth- and sixth-year classes in 1974. Table 11 shows how the system has expanded. The first group completed the course in 1977. The geographical coverage is given in Table 12; the average number of pupils per class has fallen from 39 in 1974 to 29.5 in 1978 because the system now includes the smaller classes to be found in rural areas.

TABLE 11. State of Ceará. Development of school television

Year	Number of towns	Number of schools	Number of classes	Fifth year	Sixth year	Seventh year	Eighth year	Total
1974	8	30	106	2,536	1,603	—	—	4,139
1975	29	92	286	5,831	2,633	1,231	—	9,700
1976	34	107	389	4,917	4,539	1,945	952	12,423
1977	32	111	457	4,980	3,729	3,251	1,432	13,392
1978[1]	45	nil	672	10,000	3,700	3,500	2,600	19,800

1. Provisional.

TABLE 12. State of Ceará: category and location of schools with television classes, 1977

Category	Location		
	Capital	Elsewhere	Total
State schools	102	81	183
Municipal schools	152	93	245
Private schools	—	11	11
Federal schools	—	5	5
CNEC[1]	—	11	11
TOTAL	254	201	455

1. CNEC refers to the National Campaign for Community Education.

Organization of teaching

As in Maranhão, lessons take place either in the morning or in the afternoon. The school day starts with a television serial of thirty minutes followed by thirty minutes of general discussion led by the teacher, the aim being to use concrete situations to develop the verbal fluency and critical spirit of pupils. After this the various subjects are studied. Each lesson begins with a ten-minute introduction on the television, followed by work on a number of back-up activities chosen by the teacher from suggestions in the textbook. There are many activities for small groups and even some for children to undertake on their own. At the end, each

lesson is summed up by a pupil. A vital feature of the system is that the teacher is not provided with a guide or any special instructions.

Mondays are rather different. Work begins with a set of questions designed in such a way that the ground covered in each subject may be tested twice a month. The tests are televised and corrected at once, and the rest of the day is set aside for physical education, the arts and other activities.

The system encourages but does not organize out-of-school activities and clubs. What these do and how they are run is entirely up to the teacher.

Assessment

Pupils are assessed in four ways:

The television tests, whose results are noted down by the teacher each week.

Class exercises and activities, marked by the teacher.

A mark-sheet with various headings such as attention, interest, creativeness, participation and discipline, which the teacher has to fill in.

Individual and group marks awarded by the pupils themselves; they must give themselves a mark for regular attendance, behaviour, attitude, etc. see if their classmates agree, and then hand the result to the teacher.

Each month an overall assessment is made on the basis of these four evaluations and this decides whether a pupil will move up to the next class. The Ceará TVE is only told the class average, individual results being kept by the school.

Teaching staff

Apart from the educational advisers, the Ceará TVE does not have its own body of teachers and uses those already working in the schools. In theory, however, subject teachers are replaced by a single class teacher, a requirement that raises awkward timetable problems.

Away from the capital, teachers must have completed secondary education or the equivalent and undergone a year of teacher training. In Fortaleza they are graduates of higher education, most of them in the arts or social sciences. Joining the school television system has no effect on salaries, which are fixed by the school, municipality or state.

Before new television classes come into operation their teachers gather in Fortaleza, the capital, for a three-week course. This training deals with the actual syllabus but is mainly focused on leadership techniques and how the system works.

Educational advisers employed by TVE receive a week's training and visit classes once a week. Their job is to back up the teacher, gather information on how pupils are progressing and serve as a link between schools, local education authorities and TVE.

Organization of production and broadcasting
Figure 1 outlines the rather complex but well-integrated organization of programming and production.

The initial programming, which is the responsibility of four specialists—one for each basic field of study—takes the form of a three to four page list of specifications which is then passed on to four independent units (printed documents, television broadcasts by subject, serials and tests). An educational control unit makes sure that what they produce is properly integrated.

The serials are televised each day and last twenty to thirty minutes for each level. They are arranged in series—four per year—and each separate series focuses on one or two central themes. For fifth- and sixth-year classes they tend to be dramatic in approach whereas interviews, journalistic reports and documentaries are more usual for the seventh and eighth years.

The television timetable is arranged beforehand and communicated to all the schools. Programmes for the fifth and sixth years are broadcast in the mornings from 7 to 11 a.m. and those for the seventh and eighth years from 1 p.m. to 5 p.m. The schools are responsible for servicing their receivers; the programmes, live or recorded, are used for four years. The written materials, in the form of booklets, printed in Fortaleza, are sold to the schools who have to collect them from the production centre.

The Ceará TVE has its headquarters in a specially constructed air-conditioned building of 1,200 square metres, situated in a residential district of Fortaleza, the state capital. It contains two small professional studios equipped with five cameras, three Ampex video-tape recorders and two projection rooms, as well as work-rooms, committee rooms, workshops and laboratories. The 10-Kw transmitter serves a radius of 10 km round Fortaleza but the network of relay stations, not yet complete, at present covers only 45 of the state's 141 towns.

Feedback and control
Most of the feedback is provided by the supervisors, who have a monthly meeting with those in charge of production to examine all technical and educational problems. Detailed summaries of these meetings are distributed to all staff. Information on teaching results is kept for statistical purposes only. Apart from this, pupils and teachers may write directly to the production centre and, from time to time, producers visit classes to watch the programmes.

The two systems: strong points and difficulties

The two systems have enough in common to make comparison possible. Both are based mainly on television and have their own production division and technical staff; both have their own approaches to teaching which are reflected in the organization of classes and courses, in pro-

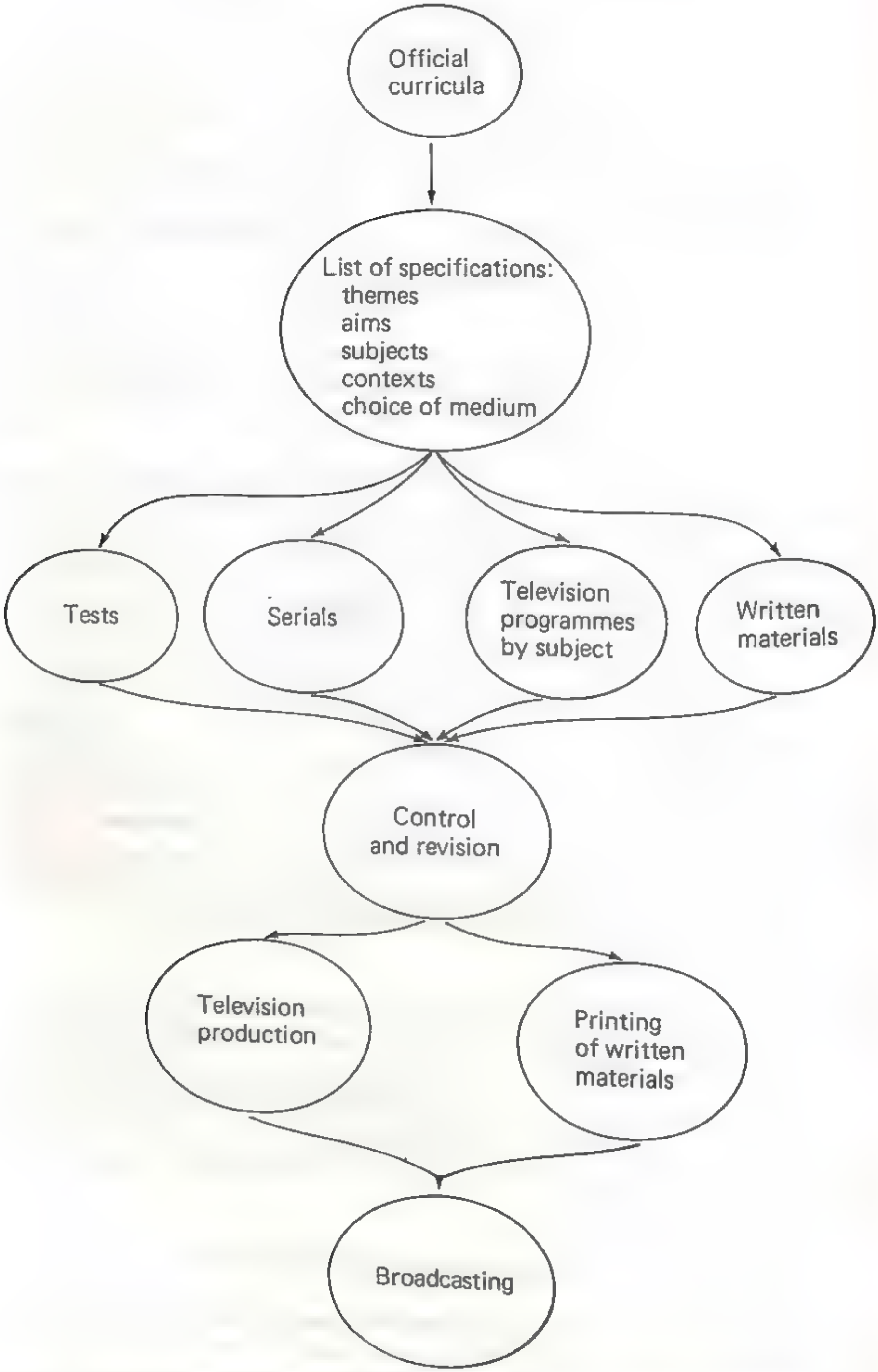

Fig. 1. State of Ceará: organization chart for production of school television programmes.

gramme style and in methods of educational assessment. Both have been set up distinct from, or parallel to, the existing educational system and often meet with hostility from the system.

The two systems, however, have different aims and are organized along different lines. In Ceará, school television keeps pace with the expansion of enrolments and is mainly designed to compensate for the low standard of general education. Although information at our disposal makes it impossible to distinguish newly formed from existing classes that join the scheme, the latter are at present more numerous. In Fortaleza, where the quality of teachers is not a problem, the relatively large number of television classes associated with the system can only, in fact, be defended by the project's need to reach a critical size in order to make educational television credible. Moreover, the fact that a single person takes over from six more specialized subject teachers, even though there is no change in the number of hours taught, still raises awkward problems. Away from the capital, the situation is different. The more poverty-stricken the town, the more easily it adopts television, though in many towns the existence of a small body of qualified teachers could create obstacles. Generally speaking, however, it is in rural areas that television is most likely to help extend the provision of schooling and improve the quality of teaching.

In Maranhão, the chief target is quantitative: to extend education to new sectors of the population. This objective has been attained, at least in the São Luís region. There have been no change-over problems since school television is, at this level, the only education system in the state. Resistance, therefore, is much less strong and expansion is governed by the capacity of the infrastructure.

There is no doubt that the superiority of the Ceará TVE is largely due to its highly decentralized structure, which explains the speed with which it was introduced. The school television service has nothing to do with the running of schools; the key figure is the supervisor, who has both educational and administrative duties. In the long run, however, the system might face problems of cohesion. The fact that schools retain their autonomy, and that the teachers remain subject to the authority of the principal and do not come under the television system, might lead to conflicts of competence. There is also a possibility that the supervisors, at present under the television authorities, will be transferred to the public sector and directly controlled by the education department. Such a decision would be bound to raise problems of liaison between the television service and the schools.

FMTVE, on the other hand, is an education sub-system with a centralized and somewhat over-staffed administration. Its main problems are internal: a ponderous institutional set-up, the need to rationalize television production and the production of written materials, and wider television coverage. But the structure itself is logical and united by a philosophy of teaching that is clearly and intentionally innovative.

III *The two school television systems: costs*

The school television systems in Maranhão and Ceará use rather different accounting techniques, and this has made it necessary to adapt our methods of estimating costs to the particular features of each.

Another point is that this analysis deals with historical costs in that they go back to the initial year of each project. For Maranhão, forecasts up to 1985, reflecting the system's development plan, have also been used.

Lastly, costs are expressed in 1978 cruzeiros by means of the deflator for Brazilian currency mentioned in Section I, page 190.

Costs of school television in the state of Maranhão

Expenditure 1969–76

Table 13 sets out annual FMTVE expenditure from 1969 to 1976. Capital expenditure can be classified by function more accurately than current expenditure, which could only be broken down in detail for the year 1976.

TABLE 13. FMTVE: total expenditure 1969–76
(in thousands of 1978 cruzeiros)

	1969	1970	1971	1972	1973	1974	1975	1976
Construction of buildings and transmitter	18,972	4,250	7,916	11,184	2,414	3,444	2,112	4,756
Studio and broadcasting equipment	8,838	6,084	2,134	1,350	772	928	386	0
Furniture for schools and centre	692	1,078	474	284	340	924	442	96
Television sets	786	2,228	26	—	—	784	210	116
Vehicles	0	464	0	94	86	96	90	90
TOTAL	*29,288*	*14,086*	*10,550*	*12,912*	*3,612*	*6,176*	*3,240*	*5,058*
Operating costs	5,160	10,432	10,892	19,540	24,550	35,740	33,040	48,334
TOTAL EXPENDITURE	34,448	24,518	21,442	32,452	28,162	41,916	36,280	53,392

Forecast expenditure 1977–85

Our detailed knowledge of expenditure in 1976 and FMTVE's plans for expansion make it possible to work out cost projections by function up to 1985 although, were the plans for expansion to be altered, the cost projections which follow would, of course, have to be adjusted too. The basic data presented here enable the financial impact of possible variations in the development plan to be deduced.

Tables 14–17 deal with cost projections for, respectively, administration, production, broadcasting and reception and utilization. In the first two cases it is assumed that real annual costs will remain constant up to 1985 with no expenditure on new buildings or new studio equipment in particular; only vehicles will be replaced.

TABLE 14. FMTVE costs projections 1977–85: administration (in thousands of 1978 cruzeiros)

Category	Annual cost
Salaries	6,146
Salary-related contributions	2,238
Supplies and services	2,184
Vehicles	100
Equipment	130
TOTAL	10,798

TABLE 15. FMTVE cost projections 1977–85: production (in thousands of 1978 cruzeiros)

	Annual costs		
	Staff	Maintenance and services	Total
Production of curricula	3,340	20	3,360
Production of television programmes	5,826	304	6,130
Preparation of written materials	1,868	40	1,890
TOTAL	11,034	364	11,398

TABLE 16. FMTVE cost projections 1977–85: broadcasting (in thousands of 1978 cruzeiros)

Year	Buildings[1]	Equipment	Vehicles[2]	Staff[3]	Operation[4]	Total
1977	8,000	3,540	300	790	312	12,942
1978	7,100	2,460	150	1,000	452	11,222
1979	8,760	2,900	180	1,612	732	14,184
1980	—	—	160	1,612	732	2,504
1981	—	1,000[5]	160	1,612	732	3,504
1982	—	—	160	1,612	732	2,504
1983	—	—	160	1,612	732	2,504
1984	—	—	160	1,612	732	2,504
1985	—	—	160	1,612	732	2,504

1. Buildings needed for extending the television network.
2. After 1981, two new vehicles per year.
3. Present staff plus additional employees for surveillance and servicing once the extension is completed.
4. Operation covers the cost of electricity, supplies and services in proportion to present real costs.
5. On the assumption that the present transmitter will be partially renewed in 1981.

Broadcasting costs (Table 16) include large sums for extending television coverage by means of new relay transmitters in three annual stages (1977, 1978, 1979) and the replacement of the present transmitter in 1981, after ten years of service.

Cost estimates for reception and utilization (Table 17) are based on FMTVE assumptions concerning the number of new classes in the area covered by the network extension and on the forecast number of pupils. School-building plans for 1977–79 will leave certain classrooms

TABLE 17. FMTVE cost projections 1977–85: reception and utilization (in thousands of 1978 cruzeiros)

Year	Number of teachers[1]	Classrooms[2]	Furniture[3]	Operation[4]	Television sets[5]: New classes	Television sets[5]: Replacements	Supplies[6]: Printing of written materials	Supplies[6]: Other supplies	Total
1977	15,326	9,472	264	4,375	326	240	2,376	770	33,149
1978	17,520	9,092	256	5,001	306	302	2,716	880	36,073
1979	21,246	14,326	416	6,063	498	402	3,294	1,066	47,311
1980	27,438	—	168	7,832	—	402	4,254	1,378	41,472
1981	33,064	—	168	9,437	—	402	5,126	1,660	49,857
1982	37,074	—	168	10,581	—	402	5,748	1,862	55,835
1983	40,688	—	168	11,612	—	402	6,308	2,042	61,220
1984	40,688	—	168	11,612	—	402	6,308	2,042	61,220
1985	40,668	—	168	11,612	—	402	6,308	2,042	61,220

1. The average monthly salary of teachers, including social charges, amounts to about 3,000 cruzeiros. The annual cost per pupil is therefore $\frac{3{,}000 \times 12}{4[illegible]} = 860$ cruzeiros. The total cost is thus N (number of pupils) × 860 × 1.32, 1.32 being the coefficient, based on past experience, to allow for absence, maternity leave, refresher courses and so forth.
2. (a) $\frac{\text{Total 1976 floor area in m}^2}{\text{number of pupils}} : \frac{100{,}000}{13{,}000} = 0.82$ m² per pupil. At 2,000 cruzeiros per square metre, the cost per pupil is 1,640 cruzeiros; (b) total cost of new classrooms: price of m² per pupil × number of new pupils concerned by the extension: 9,472 in 1977, 9,092 in 1978, 14,326 in 1979.
3. (a) Calculated at 4,000 cruzeiros per classroom at time of building; (b) after 1980, a 10 per cent depreciation rate has been calculated for all 420 classrooms.
4. These costs include supplies, salaries and salary-related contributions, invoiced services, water and electricity. They amount to 324 cruzeiros per pupil per year.
5. (a) New receivers: 4,400 cruzeiros × number of new classrooms; (b) replacements: 20 per cent of total value of television sets in stock each year.
6. (a) Printing costs of written materials: each pupil receives eight documents a year, the total annual cost of which is 2,274,000 cruzeiros. The cost of a single document is $\frac{2{,}274{,}000}{13{,}000 \times 8}$ = about 22 cruzeiros, or 166 cruzeiros per pupil. This figure (166 cruzeiros) was then multiplied by the total number of enrolments each year. Note that the result is a *cost* and not an outlay or item of budget expenditure since this sum is financed jointly by FMTVE and pupils; (b) other supplies: 57 cruzeiros per pupil, calculated on the basis of 1976 costs.

empty until the beginning of the 1980s; that is, until the new fifth-year pupils have reached the eighth year.

Cost functions

The cost functions of the system will be presented on the assumption that total costs can be classified in two categories, fixed costs and variable costs, the latter depending on the number of pupils (N) in the system. Hence the cost function is:

$$TC(N)_{78} = F_{78} + VN_{78}$$

where $TC(N)$ is the total annual operating cost of the system when it serves N pupils, F the fixed cost and V the additional cost of enrolling a new pupil.

As both F and V include capital as well as operating costs, the capital costs have to be expressed as annual instalments so that they can be then added to operating costs. The annual capital costs so calculated may be regarded as equal to the sum the system would have to pay if the equipment were bought on hire purchase instead of in cash at time of delivery.

These costs expressed as annual payments depend on three variables: the initial purchase price, the forecast life of the equipment and the economic rate or rate of interest. For purposes of comparison, the annual payments resulting from the application of three interest rates (0 per cent, 7.5 per cent, 15 per cent) have been worked out.

Table 18 breaks down the variable costs (V) per pupil per year. In this table, A gives annual operating costs, B the annual cost of capital at each of the three rates of interest, and C gives the total variable costs for each rate of interest.

TABLE 18. FMTVE: variable costs per pupil per year (in 1978 cruzeiros)

A. *Operating costs*			
Teachers		1,136	
Other operating costs		324	
Written materials		176	
Other supplies		58	
TOTAL		1,694	
B. *Annual cost of capital*	Rate of interest		
	0%	7.5%	15%
Furniture (life: 10 years)	6	8	10
Television sets (5 years)	12	14	18
Classrooms (30 years)	54	140	250
TOTAL	72	162	278
C. *Total variable costs* (A+B)	1,766	1,856	1,972

Tables 19 and 20 show fixed costs for 1976 and 1980 respectively. In 1980, broadcasting costs have changed because the system has now been extended.

TABLE 19. FMTVE: Total fixed costs per year
(on the basis of facilities available in 1976)
(in thousands of 1978 cruzeiros)

A. *Operating costs*			
Production[1]		11,398	
Broadcasting		690	
Administration		10,568	
TOTAL		22,656	
B. *Annual cost of capital*[2]	0%	7.5%	15%
Buildings (life: 30 years)	232	590	1,062
Equipment (10 years)	1,002	1,458	1,996
Vehicles (5 years)	48	118	142
TOTAL	1,282	2,166	3,200
C. *Total fixed costs per year* (A+B)	23,938	24,822	25,856

1. Operating costs for production are divided between the preparation of curricula (30 per cent), television programmes (53 per cent) and written materials (17 per cent).
2. The fixed capital costs have been based on the value of the physical capital available for use in 1976. This, as far as the fixed costs are concerned, includes: value of buildings: 6,896,000 cruzeiros; value of equipment: 10,014,000 cruzeiros; value of vehicles: 476,000 cruzeiros.

TABLE 20. FMTVE: Total fixed costs for 1980
(in thousands of 1978 cruzeiros)

A. *Operating costs*			
Production		11,398	
Broadcasting		2,344	
Administration		10,568	
TOTAL		24,310	
B. *Annual cost of capital*[1]	0%	7.5%	15%
Buildings (life: 30 years)	1,028	2,610	4,696
Equipment (10 years)	1,892	2,754	3,770
Vehicles (5 years)	48	118	142
C. *Total fixed costs per year*	27,278	29,792	32,918

1. The capital costs are those in Table 19 plus investments planned for 1977–79: 23,860,000 cruzeiros for buildings, 8,900,000 cruzeiros for equipment and 630,000 cruzeiros for vehicles.

Knowing that the system had 13,022 pupils in 1976, the 1976 cost function can be used to calculate the real average cost per pupil: at 7.5 per cent interest, it comes to 3,660 1976 cruzeiros. According to the development plan, the system will be covering 35,840 pupils in six or seven years' time. Using the 1980 cost function, the average cost at that time (applying the 7.5 per cent interest rate) will be 2,680 1978 cruzeiros a year.

TABLE 21. FMTVE: cost per pupil per year (in 1978 cruzeiros)

Number of pupils (N)	1976[1] $TC(N) = 24{,}922 + 1{,}856N$	1980[1] $TC(N) = 29{,}792 + 1{,}972N$
5,000	6,820	7,846
15,000	3,510	3,852
25,000	2,848	3,054
35,000	2,566	2,712
45,000	2,408	2,522

1. Capital costs are expressed as annual payments at 7.5 per cent interest.

Cost of the Ceará project

The Ceará TVE has a separate budget within FUNEDUCE. This budget has, on several occasions, proved inadequate, though TVE has managed to cover the deficit thanks to various donations, particularly from the social fund of Brazil's National Savings Bank.

TVE, as already stated, had two central tasks: to broadcast courses for the last four years of basic schooling (about eight hours a day except for the week-end) and to provide various other programmes such as adult education courses (the Joa da Silva programme giving the equivalent of the first four years of school, produced at Rio de Janeiro), a television magazine (produced locally), Ceará government communiqués (also produced locally), relayed sports programmes and films from other source—in all, nearly eight hours a day or as much as the school broadcasts.

Many of those at TVE work on both these tasks, so only part of their time should be charged to school television.

Ceará TVE: evolution of the budget

In 1973, the year before the school courses began, a total of 9 million cruzeiros was spent: 2.4 million on the land and building, 5.7 million on electronic equipment and furniture and 900,000 on the project staff.

TVE is managed by FUNEDUCE, but not free of charge. The FUNEDUCE budget for general administration is, in fact, equivalent to the TVE budget and should be apportioned between TVE and its other activities. If these charges are calculated in proportion to the direct costs of the various FUNEDUCE activities, the direct budget of TVE should be increased by one-seventh.

Resource allocation within TVE

The TVE organization chart shows that 30 per cent of staff costs relate to the production division, 40 per cent to the educational division, 20 per cent to maintenance and 10 per cent to administration. The production division spends an estimated two-thirds of its time on school television and one-third on other programmes, the educational division

TABLE 22. Ceará TVE: evolution of fixed expenditure (total budget less supervisors and printing) (in thousands of constant 1978 cruzeiros)

		1973	1974	1975	1976	1977	1978
Capital	Land	1,477	—	—	—	—	—
	Building	7,558	—	—	—	—	—
	Broadcasting equipment	11,850	393	13	136	7	—
	Studios and cameras	9,100	373	13	4,000	—	—
	Furniture, etc.	1,290	—	—	—	—	—
	TOTAL	31,275	766	26	4,136	7	—
Operating costs		3,350	11,240	12,650	10,706	14,273	13,418
Share of general FUNEDUCE budget charged to TVE		—	1,680	1,682	1,624	1,687	1,800
TOTAL		34,625	13,686	14,358	16,466	15,967	15,218

is fully employed with school broadcasts (50 per cent preparation of television programmes, 50 per cent production of workbooks), and the other two divisions, maintenance and administration, each devote half their time to school television, the former being attached to the production division and the latter existing as a separate service. All management costs from the general FUNEDUCE budget have been regarded as administrative costs. This cost pattern gives the resource allocation shown in Table 23.

TABLE 23: Ceará TVE: allocation of resources to school and other programmes (SP=school programmes; OP=other programmes)

Resources				
Buildings Furniture Staff Operating costs other than salaries	Production	30%	2/3 SP 1/3 OP	
	Educational division	40%	100% SP	50% television 50% workbooks
	Maintenance	20%	50% SP 50% OP	
	Administration	10%	50% SP 50% OP	
Electronic equipment (studio, transmitter)			60% PS 40% OP	

	School programmes	Other programmes
Production	2/3 of 30% = 20%	1/3 of 30% = 10%
Educational Division	100% of 40% = 40%	—
Maintenance	50% of 20% = 10%	50% of 20% = 10%
Administration	50% of 10% = 5%	50% of 10% = 5%
TOTAL	75%[1]	25%

1. Preparation of booklets, 20 per cent; television programmes, 50 per cent; administration, 5 per cent.

TABLE 24. Ceará TVE: administrative, production and broadcasting costs (in thousands of 1978 cruzeiros)

	1973	1974	1975	1976	1977	1978
Administrative costs	190	2,264	2,336	2,181	2,423	2,494
Production costs						
Television programmes	2,436	6,403	7,109	6,376	8,161	7,741
Preparation of workbooks	756	2,334	2,616	2,227	2,941	2,773
TOTAL	3,192	8,737	9,725	8,603	11,102	10,514
Broadcasting costs	711	734	735	743	744	1,244

TVE is not directly concerned with reception. Reception or utilization costs will therefore be examined in the analysis of cost functions.

Cost functions

The fixed costs (FC), i.e. costs that do not depend on the number of pupils taught, include those incurred in devising and broadcasting television programmes, producing the workbooks, and administrative costs. The variable costs include reception, the printing of written materials, the remuneration of educational advisers and class teachers, and the maintenance and depreciation of classrooms.

Although, unlike Maranhão, the majority of variable costs other than the salaries of educational advisers are not met by the centre (the workbooks, for instance, are sold) they are none the less costs and are required for purposes of comparison. Unfortunately, it was not possible to visit every school in the system to find out the costs borne by them. Classroom costs, like teachers' salaries, probably vary from one school to another—but by how much we cannot say.

Reception and teacher salaries. The centre makes various recommendations when endeavouring to persuade a school to join the system. In 1977, for example, it recommended a television set at 3,600 cruzeiros including aerial, and suggested that teachers should be paid 1,440 cruzeiros a month which, with social contributions (115 cruzeiros) and materials (200 cruzeiros a month) comes to 21,960 cruzeiros per class per year (including depreciation on the television set at 7.5 per cent). As the average class size is 29.3 pupils, the average variable cost is 750 cruzeiros, a figure that must be increased by 40 per cent to obtain the 1978 cost in 1978 cruzeiros: 1,050 cruzeiros.

Buildings. As for classroom depreciation, we saw in the section on FMTVE, for which we have precise figures, that because each classroom is used by two different classes, one in the morning and the other in the afternoon, only 0.82 m² of floor area per pupil are needed which, at 2,000 cruzeiros per square metre, gives a cost of 1,640 cruzeiros per

pupil. Spread over thirty years at 7.5 per cent this gives an annual depreciation cost per pupil of 140 1978 cruzeiros.

Educational advisers. The centre's forty-six educational advisers, paid at 2,500 cruzeiros per month over thirteen months, cost (including social contributions) 1.8 million cruzeiros in 1978 or 90 cruzeiros per pupil.

Printing costs. The workbooks are replaced each year because certain pages are filled in by the pupil. Those in charge of the system say that this avoids the problem of exercise books. Designed at the TVE centre, the workbooks are printed at a state-owned printers and invoiced at cost price. They are then sold at cost price to the schools that have signed an agreement associating them with TVE, and the schools are free to give or sell them to pupils. Certain schools do not always pay but no special measures are taken against them. Hence there are several possibilities as to who pays in the end.

In each of the system's first two years, eleven workbooks of thirty to forty pages were produced for the fifth- and sixth-year classes; this then fell to eight workbooks of seventy to eighty pages for the seventh and eighth years. In 1977 the former were sold at 8 cruzeiros and the latter at 10 cruzeiros. In addition, each pupil receives two booklets (8 cruzeiros) for religious education, and educational advisers and teachers are supplied with special handbooks for which no charge is made. Distribution is on pragmatic lines. In most cases schools outside the capital take advantage of a trip to Fortaleza to collect the documents. The variable cost of these documents is 110 cruzeiros.

Thus, in 1978, the total variable cost per pupil is:
V_{78} = 1,050 (reception and teachers) + 140 buildings
+ 90 (educational advisers) + 110 (workbooks) = 1,390 cruzeiros.
The total fixed costs are as shown in Table 25.

TABLE 25. Ceará TVE: total fixed costs (in thousand of 1978 cruzeiros)

	0%	7.5%	15%
Production of television programmes	7,741	8,370	9,145
Broadcasting	1,244	1,810	2,476
Total for television	8,985	10,180	11,621
Preparation of workbooks	2,747	2,839	2,962
Administration	2,494	2,520	2,554
TOTAL	14,226	15,539	17,137

The total 1978 cost function (TC) (at 7.5 per cent interest) is

$$TC_{78} = V_{78} \times N + F_{78}$$
$$TC_{78} = 1{,}390 \times 1{,}980 + 15{,}539{,}000$$

The unit cost (UC) is therefore

$$UC_{78} = V_{78} + \frac{F_{78}}{N}$$
$$UC = 1{,}390 + 785 = 2{,}175 \text{ cruzeiros.}$$

With the same number of pupils as in Maranhão, the cost in Ceará would be 2,585 cruzeiros per pupil, or substantially less than the FMTVE's 3,660 cruzeiros. This is because FMTVE fixed costs, particularly for production and administration, are significantly higher.

The interest rate applied makes relatively little difference: at 0 per cent the cost per pupil drops by 67 cruzeiros and at 15 per cent rises by 80 cruzeiros, a difference of ± 3 per cent, which is probably less than our margin of error. Lastly, the annual cost per pupil is \$135 at Ceará and \$225 at Maranhão.

Conclusions

In our view there are five important aspects of the cost analysis of these two systems: cost structure, cost functions, problems of optimizing the use of resources, comparison with other educational or non-educational television system, and comparison with traditional education systems.

Comparison of cost structures

Four major categories of cost are now established: administration, production, broadcasting, reception and utilization. When these are compared, the total costs for the two systems work out as shown in Table 26:

TABLE 26. Cost structure of the two systems (in thousands of 1978 cruzeiros)

	Maranhão (1976)		Ceará (1978)	
	Total	%	Total	%
Administration	10,976	22.5	2,494	6.0
Production	12,127	24.9	10,514	25.2
Broadcasting	1,419	2.9	1,244	3.0
Reception[1] and utilization	24,169	49.6	27,522	65.9
TOTAL	48,691	100.0	41,774	100.0

1. Including printing costs for workbooks.

The closeness of the results is surprising. Production costs account for the same proportion (a quarter) of the totals but are a little (15 per cent) higher in absolute figures in Maranhão. When allowance is made for the fact that Maranhão's television programmes are considerably more sophisticated and that its production facilities, unlike Ceará's, are not

used for non-educational broadcasts, production costs may be regarded as very similar.

The same conclusion may be drawn from an examination of broadcasting costs, also identical in percentage (3 per cent). The Ceará network is more developed and hence more costly but it is also better utilized since it transmits a higher proportion of non-educational programmes. It should be noted that Maranhão has recently changed its policy in this respect and programmes not related to school television, non-existent until 1977, are becoming increasingly numerous. This, however, should not raise hopes of lower broadcasting costs in Maranhão since current efforts to extend the system's coverage are concentrated on less-accessible regions.

Reception and utilization costs, for their part, account for half the total costs in Maranhão and two-thirds in Ceará. This is a question of scale since Ceará has more pupils. On the other hand, unit costs are rather lower in Ceará though there is, in fact, very little reliable information on this matter.

This result seems illogical and should be treated with great caution, since the teacher–pupil ratio would strongly suggest the reverse. The average size of classes in Maranhão was, in fact, forty-one in 1976 as against a little over twenty-nine in Ceará (1978) i.e. over 25 per cent less pupils, which ought to increase Ceará's variable costs.

If an opposite result is obtained, the reason is firstly because Maranhão's teachers are better paid than their counterparts in Ceará. It must be realized that the salaries of teachers with the same qualifications are not uniform throughout Brazil but vary from state to state and according to whether the school is a federal, state, municipal or private one, etc. Furthermore, the class teachers in schools associated with the Ceará television scheme do not all have the same status but retain that of the school they work for. In Maranhão, on the other hand, they are all paid by FMTWE and for this reason might be in a position to exert more pressure for higher salaries.

The second reason for a result contrary to expectations relates to the administration of schools: there is no information at all on the cost of running the various schools that have joined the Ceará scheme. Most of them are small, averaging under four television classes each. Some probably have their own administrative staff but others will be managed directly by state or municipal officials who have other duties as well. Maranhão's schools, on the other hand, are larger on average and FMTWE has had to supply administrative and service staff, thus somewhat distorting the comparison to its disadvantage. This is why we suggest that the differences in reception costs between the two systems should not be given undue importance.

One more factor also distorts comparison in an unexpected way. This is the geographical distribution of schools. FMTWE is mostly concentrated at São Luís and in the surrounding towns and villages whereas the

Ceará TWE spreads out much more into rural areas. This ought to make reception costs in Ceará higher (communications, distribution of workbooks, etc.) but they are in fact lower, for the following reason.

FMTWE has five vehicles with drivers for its contacts with the various schools, but lack of resources obliges the Ceará TWE to proceed in less methodical fashion. The workbooks are got to the schools by any means available—picked up by a passing teacher or villager, for instance—visits are few and far between and feedback minimal. Costs are lower but the service provided is different too, another reason for emphasizing once again that comparison has its limits. It should also be noted that the costs of printing the workbooks distributed to pupils are particularly low (less than 10 per cent of the variable cost per pupil) when set against their contribution to teaching.

The only substantial difference concerns administration costs, which are four times higher in Maranhão than in Ceará. This is chiefly because Maranhão decided to administer the schools in the project directly whereas, in Ceará, they remain under the usual authorities.

Comparison of cost functions

The two cost functions are: Maranhão: $TC(N) = 24{,}822 + 1{,}856\ N$; Ceará: $TC(N) = 15{,}539 + 1{,}390\ N$. They are plotted on Figure 2.

In this figure, the difference in unit costs between the two systems is expressed by the broken line OA which is itself made up of OB′ (effect of difference in size—about one-third of total difference) and AB′ (difference in variable costs—about the two-thirds of total difference).

It emerges that, with 20,000 pupils, the Ceará TVE is big enough to bear the fixed costs occasioned by television. Expansion from 10,000 to 20,000 pupils lowered unit costs by nearly 1,000 cruzeiros whereas an additional 10,000 pupils will only reduce them by a further 200 cruzeiros. In Maranhão, on the other hand, increasing enrolments to 20,000 would lower unit costs by 700 cruzeiros and to 30,000 by 400 cruzeiros more. It is therefore clear that Maranhão is in urgent need of more enrolments.

Optimizing the use of resources

We have been unable to examine in detail the conditions for optimizing the use of production resources in the two projects. Indeed, there is no real need because this is clearly not a problem for either of them. Available equipment is used intensively, with Ceará broadcasting for sixteen hours a day, of which ten hours are produced locally, mostly live, and Maranhão putting out eight hours of school broadcasts plus a growing proportion of other programmes—educational, cultural or light entertainment—in the evenings. One can only hope that the Maranhão scheme will pursue and develop its policy of broadcasting programmes not related to school television in order to reduce the fixed costs of broadcasting to schools. On the other hand, the plan, not yet put into practice, to buy equipment for making films should be treated with reserve. The new costs implied are

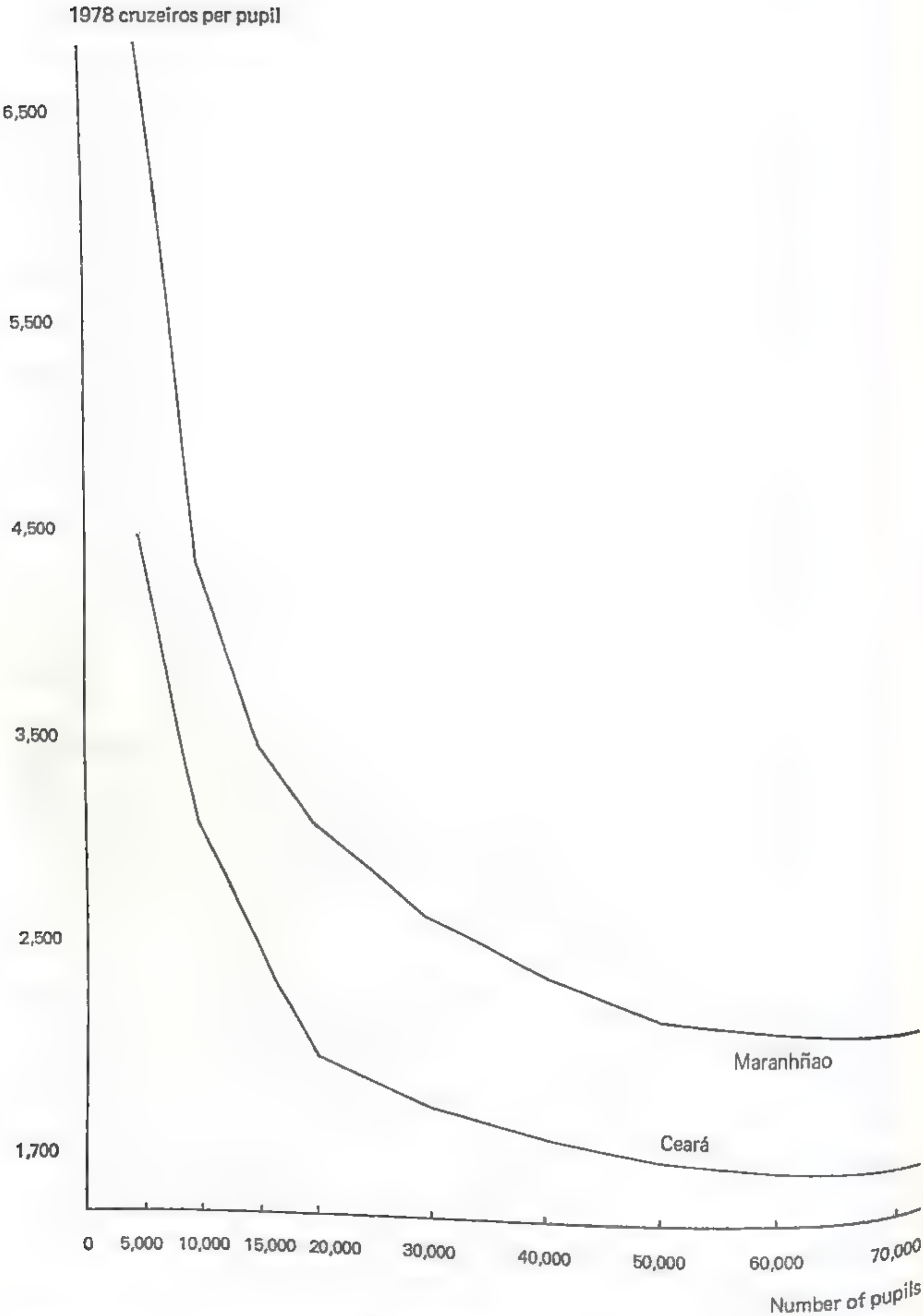

FIG. 2. Cost functions of the two projects. Lines A and B indicate the actual situation of the two systems at the time of this report.

considerable and the educational advantages uncertain and, in all probability, impossible to determine with the available means of evaluation.

Comparison with other educational or non-educational television systems

The best known systems of educational television are that of the Ivory Coast, and the Open University in the United Kingdom. Both have been subjected to economic analysis and show much higher programme production costs for far fewer hours of broadcasting than is the case in Maranhão and Ceará. The distinguishing feature of the two Brazilian systems is that they possess their own transmitters and the beginnings of a relay network whereas the other two make use of extensive networks already in existence (full coverage in the United Kingdom, and almost full coverage in the Ivory Coast). Such differences reduce the possibilities of comparison, yet our impression is that the two Brazilian systems, which are entirely run by local staff, organized in a practical way and well attuned to local conditions, have no reason to be ashamed of the comparison.

In comparison with non-educational television systems, Maranhão and Ceará stand out by their refusal, as a matter of principle, to insist on 'professional' standards. Resources are limited and they are content with straightforward products commensurate with those resources. Production teams are kept as small as possible, with an emphasis on amateur resourcefulness that would probably shock professionals but without which there would be no television for schools.

Comparison with traditional system of education

In comparing the Maranhão and Ceará projects with traditional systems, one important fact to be taken into consideration is the very considerable decentralization of the Brazilian system of education, which results in an extremely wide range of situations. The cost per pupil per year for the fifth to eighth years very probably varies from 500 to 10,000 1978 cruzeiros according to whether the pupil is at a very poor municipal school in a poverty-stricken state or at a private school in a rich state. In Ceará and Maranhão the gap between the municipal school of a remote village and the smartest private school of the capital is probably as wide.

We consider that the quality of education provided by television schools in both systems falls midway between that of the state schools in Fortaleza and São Luís and their four or five top private schools. The fees of these non-subsidized private schools, which may be regarded as unit costs, vary from 4,000 to 6,000 cruzeiros per year, a lot more than the figures arrived at in our cost analysis of the two projects.

Compared with state schools in the two capitals, it may be said that Ceará TVE unit costs are roughly the same and those of the FMTVE slightly higer.

On the whole, and judging by the information at our disposal, we believe that the costs of the two systems are not excessive.

General conclusions

Analysing the cost of a project is not an end in itself: its purpose is to help gauge the pertinence of the technological choice made. This therefore calls for further information, namely the value of the product obtained by means of the resources employed. In the present state of knowledge, however, it is not yet possible to measure, with the aid of economic indicators such as monetary units, the absolute value of an educational process. We have to fall back on relative criteria such as 'at the same cost, what educational technology leads to the best results?' or 'for the same results, what is the least costly educational technology?'.

What is here called 'product' or 'results' is really a many-sided phenomenon whose evaluation requires a wide range of standardized and carefully prepared data that are, unfortunalety, rarely available: data on access, repeaters, drop-outs, examination passes, indirect social effects, and so forth.

In Ceará, the school television system is still too young for a sufficient number of results to be observable and the budget is so tight that little can be spent on evaluation.

The Maranhão project, on the other hand, is more established and more concerned with evaluation. This explains our success in gathering together a few partial indicators. Nevertheless, they are not enough to support a true analysis of cost effectiveness since there are no other strictly comparable systems about which similar data are available.

Remarks on the effectiveness of school television in Maranhão

FMTVE pupils have two dominant features: they come from a very modest social background and are much poorer than private-school pupils, being generally less well-off than most pupils in fifth-to eighth-year classes. Secondly, their standard on entry is low. Judging from the tests

TABLE 27. FMTVE: promotion, attendance and drop-out rates

Year	Promotion rate	Attendance rate	Drop-out rate
1969/70	98.0	—	3.8
1970/71	98.2	—	2.5
1971/72	98.6	92.0	2.1
1972/73	98.5	96.0	4.4
1973/74	97.4	94.0	5.2
1974/75	93.2	91.0	9.2
1975/76	91.5	91.0	7.1

Source: FMTVE/CEPI.

they have to take, they know only a third of what is theoretically required for admission to this level.

The promotion, attendance and drop-out rates shown in Table 27 may be regarded as good, comparable to those of private schools and certainly better than those of pupils from a similar background in other schools.

Table 28 compares the results of FMTVE pupils with those of pupils from private schools in the São Luís area in the entrance examination to (upper) secondary education in 1973 and 1976. In 1973, a perfectly equal competitive examination saw FMTVE pupils obtain markedly better results. Although the 1976 results again show the clear superiority of FMTVE candidates, they are more difficult to interpret because social criteria in favour of the children of low-income parents (and hence FMTVE pupils) were applied in the entrance examinations to one of the leading upper secondary schools.

TABLE 28. Passes in entrance examinations to secondary schools

	Number of candidates	Number of passes	Percentage of all passes	Percentage of successful candidates
1973 FMTVE	1,127	687	43.0	60.0
Other schools	2,548	894	57.0	35.0
Total	3,675	1,581	100.0	—
1976 FMTVE	2,670	1,451	58.6	54.3
Other schools	2,985	1,026	41.4	34.4
TOTAL	5,675	2,477	100.0	—

Despite these reserves, it is not unreasonable to conclude that FMTVE is succeeding in its efforts to transform a population initially ill-prepared and from poor homes into a very active group with a high degree of success at school. Its work is a powerful stimulant to social mobility within this group to the extent that social mobility depends on success at school.

Results of school television in Ceará

Unlike Maranhão, the pupils of the Ceará TVE are not from a particularly underprivileged social background. In the capital they are rather like the pupils in state schools and, in the rest of the state, comparable to the pupils of private and municipal schools covering the fifth to eighth years. The promotion, repeater and drop-out rates are much the same as in traditional schools.

As for access, it should be observed that the system has reached a workable size in a few years. This is certainly a point in its favour, but

it is not known what proportion of the pupils are from existing classes that have simply joined the scheme, as against newly created classes. However, it can be said that, for many pupils in rural areas, the system has helped increase their chances of access to the last four years of basic schooling.

The information at hand is very limited but warrants the cautious judgement that the results are no worse than in other comparable schools. Moreover, the fact that the system, based as it is on voluntary association, has expanded rapidly is strong evidence in its favour.

Final remarks

A thorough analysis of cost effectiveness would have required more data on the two systems as well as on the traditional schools. The innovatory nature of the two experiments amply justifies such an undertaking, especially as, in this case, the contexts are similar, a fact that facilitates comparison. The systems also possess many common features which should make it possible to highlight the marginal effects of the differences in basic concept. The Maranhão school television is particularly rich in new ideas since it embodies not only a new educational approach using television but an original philosophy of teaching based on a high degree of pupil responsibility, independence and participation. It has also proved itself to be effective in attaining one of its initial goals—to give children living in the poorer suburbs of the state capital a better chance of schooling. The Ceará TVE has kept in closer touch with the traditional system of education, being content to remedy the shortage of qualified specialist teachers by means of television. It, too, nevertheless has interesting and novel features, such as the 'integrated' class at the start of the day's work in which the young heroes of a television serial serve as a means of introducing the new ideas to be explored in the various subjects during the day.

In sum, these two projects, developed in two poverty-stricken states with nothing but their own resources and local skill, may be regarded as significant contributions to the search for the educational solutions of the future.

Costs and effectiveness of distance learning at the post-secondary level

Leslie Wagner

Introduction

The central theme of this study is the ability of economic analysis to inform, illuminate and influence decisions on the use of media for distance learning at the post-secondary level of education.

Many systems provide further education facilities for adults to enable them to study subjects missed or under-achieved at school. These are cases where the age of the student will be post-secondary but where the curriculum remains at the school level. This study is not concerned with such systems but concentrates on those where both the age of the student and the level of education is post-secondary.

While the study deals with economic concepts, it is written so as to be comprehensible to non-economists. It is not merely concerned with the economic analysis of media but with the relationship between economic analysis and media decisions.

Is post-secondary education different?

Does post-secondary education have any distinguishing characteristics that require a different analysis of the use of distance-learning media? This must be our first question for if post-secondary education is no different from school education in this respect there seems little point in a separate analysis. The lessons of using media in school education or in training could simply be applied to post-secondary education.

There are of course some general characteristics of media use in education, particularly on the costs side, that apply to all levels of education. In the language of economists, the use of media changes the production function of education. More generally, the ratio of capital to labour for any give amount of education increases.[1] The use of print,

1. It might be useful to amplify this a little. In accounting terms capital is usually regarded as a fixed cost and labour as a variable cost. This is because the terms fixed and variable are related to time or the particular accounting period. In economic terms, any capital costs would be annualized (see page 13 for explanation of the method adopted) and the terms fixed and variable would be related to a particular output. In education, for example, student or pupil numbers

radio, television, film, etc. requires capital equipment which reduces the labour input for a given number of students, or more usually, allows a larger number of students to be taught for the same amount of labour (i.e. teacher) input. As a result, the general cost characteristics of media systems in relation to more conventional education systems are a higher level of initial cost, a lower level of marginal cost once the system is in operation, and a more rapid fall in average cost as the system expands.

These general lessons are important and will be illustrated by the examples given later in the study. However, post-secondary education does have specific characteristics which affect the use of distance-learning methods and have implications for costs-and-effectiveness analysis.

As mentioned earlier, post-secondary education is defined both in relation to the age of the student and the level of the curriculum. In other words, it is assumed that the students participating in the system are of post-school age and the curriculum they are following is also at the post-school level. These two features can have important effects on the distance-learning system adopted and any costs-and-effectiveness analysis of such a system. A third feature is the external economic and educational environment within which such systems operate.

Age and maturity of student

By definition, the post-secondary student will be at least in late adolescence and in some cases older. This has implications for the media mix and, in particular, the balance between media and live instruction.

There may be sound pedagogical reasons for an element of live, face-to-face, personal interactive instruction in any educational system. Indeed there are few systems at the post-secondary level which do not include such an element. However, where school-level education is concerned this is essential and not necessarily for any intrinsic pedagogical reason but simply to maintain order and ensure that attention is being paid.[1]

might be regarded as a measure of output. The relevant question then is which inputs of capital and labour are fixed as student numbers rise and which vary. With media systems, both capital and labour inputs may be fixed as student numbers rise. For example, increasing the number of students who watch a television programme may involve no extra costs at all. If more television sets are required, then capital costs rather than labour costs will increase.

1. It can be argued that no one needs to ensure that attention is being paid to television programmes such as *Sesame Street* in the United States, and if all television instruction could reach these levels this personal supervision element could be eliminated. However, it is unusual for children to be left entirely on their own in such a situation. A parent is somewhere in the vicinity. Moreover, leaving one or two children unattended is different from leaving up to thirty or more in the same situation while to produce programmes of a quality that allows no personal supervision is likely to have high-cost implications. It may be more cost effective to go for lower technical quality with an element of supervision.

It is likely, therefore, that school-level distance-learning systems will include a larger proportion of face-to-face tuition if only to allow for this personal supervision element. Economies are still possible within this constraint however. The personal supervision element may allow a much higher pupil/teacher ratio than would be necessary if all tuition came from the teacher. Alternatively, the use of media may allow a less expensive teacher to be substituted for a more expensive one. (See, for example, 'The Mexican Telesecundaria: A Cost Effectiveness Analysis', *Instructional Science*, 1975 and 'Mexico's Telesecundaria', *The Economics of New Educational Media*, Vol. 1, Unesco, 1977). The major point still remains that school-level education requires a personal supervision element.

At the post-secondary level, supervision is not required and this has important cost implications. In principle, it allows the economies of scale inherent in the use of distance-learning systems to be optimized without being diffused through a large and more costly face-to-face element. The potential ability to reduce average costs significantly below the figure for conventional education is not constrained by the need to include major elements of this more costly alternative. How far this potential ability is realized in practice will be discussed later but it is an inherent characteristic of post-secondary education that the age of its students provides media use with its greatest cost-reducing opportunities.

Nature of the curriculum

The assumption that the level of curriculum is also post-secondary is important, particularly for effectiveness studies. For the nature of the curriculum in higher education is likely to be different from that in school education. In the latter the cognitive objectives of a particular system of instruction are often more easily specified, and the skills to be acquired more easily identified. It is possible to design standardized tests capable of measuring whether these objectives have been achieved.

In post-secondary education, the general analytical and synthesizing skills acquired are more difficult to measure. Evaluation in the conventional system is traditionally of a subjective nature with the scope for standardized tests useful for comparative purposes being very limited.[1]

This difference is reflected in the paucity of studies on the educational effectiveness of post-secondary distance-learning systems. This paucity partly reflects the novelty of these systems. In some cases they have not been in existence sufficiently long for any useful study to have been made. Even with systems of longer duration, however, there has been only limited study of their educational effectiveness. The usual assumption that has been made is that a pass in the distance-learning system is

1. Attempts to overcome this have been made in certain subject areas including, appropriately enough, economics. See, for example, publications by Attiyeh, Bach and Lumsden (1969) and Attiyeh and Lumsden (1971, 1972).

equivalent to a pass in a conventional-learning system and the educational effectiveness of the media system is thus determined by the comparative pass rate.

Even if some more objective, standardized measurement of the cognitive effectiveness of such systems was devised, this would not necessarily be the major factor in determining educational effectiveness according to Carnoy and Levin. In a review of a number of studies of using instructional technology in both school and post-secondary education, Carnoy and Levin (1975, p. 390) comment:

> In almost all cases a narrow measure of educational attainment is used to assess educational outcomes or no measure of effectiveness is used at all. Is it appropriate to assume that students receiving videotape instruction in factories are receiving the same education as those on campus who have regular access to faculty, other students or libraries? Is it correct to assume that the value of an Open University degree will be similar to one from Oxbridge or the 'Red Bricks'? Such a presumption simply ignores the credentialing effect of higher education institutions as well as the fact that Open University students are not being socialised in the same way as their counterparts in traditional universities. The latter students are spending most of their time in contact with fellow students, faculty and academic facilities that go far beyond the short exposure to course instruction and required instructional materials.

Carnoy and Levin thus argue that measures of cognitive effectiveness would only be part of the overall educational outcomes of a particular system. The relevant question is whether what is omitted by a cognitive measure alone is important. If cognitive achievement is our major or only objective, then this becomes our major or only measure. Carnoy and Levin (1975, p. 391) go on to argue against this approach by questioning the assertion in most effectiveness studies that

> Comparisons of newer educational technologies with the more traditional alternatives show no significant differences between the two approaches on student test scores. Generally such evidence is based on testing a relatively narrow domain and generalizing this to all educational impacts. (Chu and Schramm 1967; Schramm 1973; and Jamison, Suppes and Wells 1974). . . Yet none of these studies considers the other factors that are evident in traditional instructional systems that affect both cognitive and socialisation outcomes. Further, recent analysis of the determinants of earnings suggest that cognitive factors are not very strong predictors of income and other measures of lifetime success; and that the non-cognitive aspects of school socialisation seem far more important factors in determining such outcomes (Gintis 1971; Bowles 1973; Bowles & Nelson 1974).
>
> By omitting these other factors, the claims of 'equal success' in educational results is unsupported and derives from a narrowing of what constitutes success to the specific test instrument used to assess instruction rather than to assessing the wide range of outcomes that schooling contributes to.

This fundamental criticism is largely related to the educational reform objectives of many distance-learning systems in both school and post-

secondary education. While it is necessary to bear in mind that a cognitive measurement is a narrow one, it is at least a start. In many distance-learning post-secondary systems such information would be a major advance on what we know at present about their educational effectiveness.

There is a further aspect of the nature of the curriculum in post-secondary education which has implications for the analysis of distance-learning systems, this time on the costs side. Radio and television media in particular have both a production and a delivery component. It is possible to use the delivery component alone to expand the student audience for a particular piece of instruction. In other words, radio and television allow some conventional instruction to be made available to a larger number of students than might be able to attend at the time and place at which that instruction is given. This audience can be either on or off campus and the instruction can be delivered by a variety of transmission mechanisms. The systems can be used for live or recorded broadcasts and with live systems in particular student–teacher interaction can be accommodated.

Television and radio also have a production capability to provide a form of instruction different from that normally experienced in the classroom. This can involve the use of many audio-visual aids such as films, slides, charts, diagrams and cartoons together with dialogue and interview material. Programmes involving these methods might be designed to teach material which cannot be taught through a simple lecture procedure or to enable more effective learning to take place or to allow the student to learn more quickly.

In school education, television and radio are used both for their production and delivery capabilities. It is unusual to see the media being used simply to duplicate what is taking place in the classrooms. The programmes at the very least are usually specially prepared for the distance-learning system. In post-secondary education the delivery component is used by itself much more often. Of the systems discussed later, both the Stanford Television Service and the Colorado State University SURGE project simply extend what is already taking place on campus to a wider audience. No special programmes are made and the audio-visual system is used specifically for its delivery component.

The costs implications should be clear. The delivery component of an audio-visual system is much cheaper than its production component, particularly if transmission can use an existing system. This is an additional factor likely to reduce the costs of using media in post-secondary rather than school education.

External economic and educational environment

Media systems often encounter substantial teacher opposition. This is not surprising, for the dry language of the economist—substituting capital

for labour—is instantly translatable by the teacher into substituting machines for people and the loss of jobs. As a result the use of media in education generally falls into one of three categories.

Media can be used within the existing system to supplement the teacher input and thus increase the quality of the overall educational input (although not necessarily the quality of the educational output). Many of the audio-visual aids found in most schools and colleges or the public educational radio and television broadcasts come into this category. The teachers in the classroom still control the pattern and content of study and use different media to help them in this task. The media do not represent a threat to their job security.

The second category is where media are used to extend opportunities to students not already participating in the educational system or a particular part of it. Here media will be used to overcome educational, geographical, physical or social handicaps either by extending existing conventional tuition methods to this wider audience or by establishing new approaches, institutions or systems. The objective of such provision may simply be to extend opportunity provided quality is no worse and costs no higher than the existing education provision, rather than to improve quality or to reduce cost. Here, too, there is no threat to existing teachers since the system is being expanded. Although it could be argued that as a result of using media fewer teachers will be required than if conventional methods had been used, it is also often the case that no expansion would have occurred if the conventional approach was the only method available. In any event expansion using media usually involves some increased use of teachers.

The final category also involves expansion but in this case the objectives of either improved quality or reduced cost are much more explicit. Here teacher agreement or acquiescence is less certain if only because the achievement of either of these objectives may have implications for the conventional system. There may thus be a longer-term effect on employment or at the very least on established working patterns.

The first category is not the concern of this study. Most post-secondary institutions have audio-visual sections which carry out the functions previously described. They contribute only marginally, however, to distance-learning objectives and, where they do, it is as part of a larger, often separately constituted organization. Their major function is to supplement and improve the quality of on-campus instruction.

The central characteristic of the other two categories is that they seek to expand the system against a background of resource constraint. It is generally though not invariably true that this characteristic is most common in post-secondary education in developed economies and in primary and secondary education in developing economies.

The richer economies generally have compulsory education up to the age of 16 and above. The scope for expansion of these systems is thus limited. It might come about through a growth in the birth rate, which is

unlikely, or through a raising of the compulsory schooling age, the scope for which is limited.

Distance-learning systems in developed economies therefore largely cater for the post-secondary age group. The level of education of such systems may, however, be both pre- and post-secondary. Many systems coming into operation are of a remedial nature, attempting to provide adults with skills and concepts appropriate to school-level education. Others are at the post-secondary or specifically higher-education level and attempt to expand opportunities in this area for those qualified for conventional higher education while also maintaining and with an open-learning, no-prior-qualifications approach.

The expansion of post-secondary education is not the most urgent educational concern of most developing countries. Here, where compulsory education may only be possible up to primary level or where geographical or other problems make comprehensive provision difficult, the priority for media-system use is to extend school education. This is apparent from the studies mentioned in *The Economics of New Educational Media*, Vol. 1 (Unesco, 1977) and the World Bank publication, *Radio for Education and Development: Case Studies* (1977).

In view of the above it is not surprising that most distance-learning systems at the post-secondary level are found in developed economies. There are exceptions, such as the Free University of the Islamic Republic of Iran and the Everyman University of Israel, but these are usually regarded as special cases. Inevitably, therefore, the studies now to be analysed have a developed country context. Nevertheless, it is hoped the analysis will be of interest to a wider audience. As other countries become more interested in extending media to provide distance learning at the post-secondary level there is much to be learnt from the experiences of those who preceded them.

Summary

It has been argued here that post-secondary education distance-learning systems have specific characteristics that merit a separate analysis. There is first the age and maturity of students which remove the need for a large element of personal supervision. This enables the economies of scale inherent in media systems to be fully exploited.

Secondly, there is the nature of the curriculum. The broad analytic and synthesizing objectives of post-secondary education make it more difficult to objectively measure cognitive performance. The result is that most studies accept a pass as being of equal value whatever the system or method of tuition. On the costs side, the nature of the curriculum allows television and radio to be used for their delivery capability alone, thus enabling student numbers to be expanded at very low marginal cost.

Finally, the context in which media systems are introduced into education means that distance learning at the post-secondary level takes

place almost exclusively in developed countries. The lessons to be learnt from these pioneering efforts will, it is hoped, be of use to others when they come to extend their media systems to the post-secondary level.

The studies chosen

While increasing numbers of post-secondary distance-learning systems are being established, the number of cost or effectiveness studies of such systems is relatively small. Many innovations are too recent for any useful study. Moreover where an analysis has been carried out, this has often been for internal purposes and the data have been organized and categorized in a form which makes a comparative analysis very difficult. Thus the number of studies which provide reasonably reliable data capable of being compared and conforming to the methodological approach outlined in Volume 1 of *The Economics of New Educational Media* is very small.

Four studies have been chosen. These reflect not only a variety of different media approaches to distance learning but also point up the different lessons to be learnt from each study. The Open University in the United Kingdom has pride of place not only because it has been more thoroughly studied than other systems but because it provides the most comprehensive approach to distance-learning education.

Moving from the large-scale innovation of the Open University to two extensions of existing provision on a much smaller scale, there is in the United States first the SURGE project at Colorado State University. This provides off-campus graduate education through the use of video tape. Second, there is the Stanford Television Service which provides both on- and off-campus education, this time through the use of live television. Finally, a study of the PLATO computer-aided instruction system at the University of Illinois is included. This uses a different form of media but is also useful in indicating the essential cost characteristics of distance-learning systems and some problems of their implementation.

The context of the studies

Any consideration of the relevance of economic analysis to decisions about the use of educational media requires that the usefulness of these studies to various types of decisions be established.

Many decisions are involved in the use of media. There is the initial decision, to begin at all. How can cost analysis influence and help

to inform such a decision? This will be subject-matter of the next section where the PLATO study will be used as an example.

There are many decisions to be taken once a project is under way. These include whether the project should be finished, continued or expanded. Cost-and-effectiveness analyses are particularly relevant to these types of decisions as the Open University and Colorado studies indicate.

Finally there are decisions as to how the benefits from any cost reductions resulting from the learning system should be allocated. There are a number of possible beneficiaries which include the provider of funds, the administration of the institution, the teaching staff and the students. The Stanford study illustrates this particular question.

The initial decision

The initial decision to introduce a distance-learning system may take a variety of forms. It may be implemented in stages from experimental through pilot to full project status. It may involve establishing a completely independent system or one which in a variety of ways builds on what already exists. It involves complex questions of establishing the media mix linked to educational and wider objectives.

The essential cost information required at this initial stage will include total cost, its distribution between various partners (including the students) and average cost per some measure of output which is usually the number of students. In accounting terms, total cost is usually divided between capital and recurrent costs. In economic terms, the capital cost is converted into an annual cost of capital services through the use of an appropriate interest rate (to measure the cost of capital) and depreciation rate (to measure the wastage of capital). The formula for this conversion given by Jamison, Klees and Wells (1976) is

$$\frac{(r(1+r)^n)}{((1+r)^n-1)}$$

where r = the appropriate rate of interest which on public projects would be equal to the social rate of discount and
n = the lifetime of the capital.

This annualized cost of capital services is then added to annual recurrent costs to provide a total annual cost of the project.

Where the approach is to use or build on to a media or other distance-learning system that already exists as at Colorado and Stanford the initial decision is not too difficult. The resource commitment is relatively small and the costs and student demand are likely to be known. The

introduction of the system is in the nature of a marginal addition to what already exists.[1]

However, where a new system is being introduced these three elements of initial resource commitment and knowledge of costs and of demand can make the decision a very difficult one. The initial resource cost of a self-standing distance-learning system is likely to be much larger than that for a conventional learning system because of the higher threshold effect in the former. In a conventional-learning system costs (inputs) are much more closely related to student numbers (outputs). While some threshold is still in operation, it is at a much lower level and a new college or university can be introduced on a relatively small scale with a low level of resource commitment.

This, of course, does not always hold. It can be argued that to provide an adequate range of courses a college must be of a certain minimum size which will involve capital and recurrent resources running into millions of dollars. Even if this were so the risks involved in such an expenditure are not as large as with a distance-learning system because of the uncertainty over the costs and demand data associated with the latter.

A conventional-learning system by definition uses conventional technology. The costs associated with establishing an institution of a certain size can normally be forecast with a high degree of accuracy, as numerous models exist on which these forecasts can be based. Demand, too, is usually guaranteed. The pressure to establish a new institution usually comes from the demand side. Unless a serious miscalculation has been made it is unlikely that such an institution will remain under-utilized. Hence, forecasting total cost, student numbers and thus average cost per student can usually be done with a great degree of certainty.

Moreover the penalties for over-optimistic forecasting are not too great. Because of the closer proportionate relationship between inputs and outputs a fall-off in student numbers can be balanced by a reduction in inputs. This may, of course, be difficult to achieve in practice for political reasons but overall the rise in average costs per student above that forecast as a result of underestimating cost or overestimating demand will not be too great.

1. This is not to say that problems for cost analysis do not exist. A major difficulty where resources may be shared across a number of different projects is to allocate appropriate costs to each project. If a university television service is used, for example, as an audio-visual aids centre for live lectures, to provide close-circuit facilities on campus and as part of a distance-learning system, what is the correct allocation between these three different uses?

In reality this problem is more of a political than an economic one. Project directors will spend a great deal of energy arguing over whether the allocation of a secretary's or technician's time to his project is correct while accepting the depreciation rate at which his capital equipment is to be amortized without a murmur. Yet lengthening the life of a project by a year or two in a calculation of annual costs will often provide the resources to pay for any number of extra secretaries or technicians.

The opposite conditions usually characterize a distance-learning system. On the costs side, each system tends to use a different media mix, so that imitatory models often do not exist. It is difficult to take an existing model off the shelf and duplicate it. Most distance-learning systems are custom built and their cost estimates must be built up independently. Furthermore the technology in this area is changing far more rapidly, so that even if a system uses a similar media mix to one of a few years ago the cost components of that mix may have changed significantly. Hence cost estimating is a much more uncertain business.

Demand estimating is also much more difficult. Distance-learning systems are often introduced to further educational reform. At the post-secondary level they have been designed to overcome educational, social or geographical disadvantages. When the systems are being advocated, as with the Open University or Colorado State University, it is argued that a latent demand exists. But an accurate forecast of the extent to which this potential demand will translate into reality is often not possible. Establishing a distance-learning system in post-secondary education is, as far as demand estimates are concerned, very much an act of faith.

Distance-learning systems are therefore likely to involve high initial costs. These together with the uncertainty attached to cost-and-demand estimation, make the decision to go ahead a difficult one. There is a further complicating factor, however. For the picture facing the decision-maker after he or she has made a decision is vastly different from that beforehand. Once the project is under way, the high capital costs have been incurred, the programmes or courses have been made, and the equipment is in operation. The actual costs to be saved from drastically reducing the scope of the system if demand is not forthcoming are likely to be very small.

Cost-and-demand analysis at the initial stage thus has a heavy responsibility. Faced with the uncertainties involved, it may be all too tempting for the analyst to take the lowest estimate of cost and the highest estimate of demand in order to indicate the potential economic advantages of the system. If subsequently the average cost-per-student estimate is shown to have been too low, it can be argued that in the existing situation of a system in operation with low marginal costs continuation of the project is justified.

It should be pointed out in passing that two techniques of overcoming these problems can be advocated. There is sensitivity analysis in which the effect of changing various input assumptions on output is measured. In the example above the effect of differing cost-and-demand estimates on the average cost-per-student calculation would be indicated. Second, there is the technique of allowing for different time horizons of cost-and-student utilization. Jamison, Klees and Wells (1976) discuss this in some detail and their publication should be referred to for fuller information. Essentially, it allows the decision-maker to assess average costs

at any time i over any projected life of a project j. Thus at the initial stage, i may be the year before the project is introduced and j may be all periods up to ten years. Here the decision-maker can see the cost implications of going ahead now but stopping the project in any year 1 to 10. After the project has started i may be any year during its life. Thus the decision-maker can see the differing cost implications over different time perspectives.

The PLATO project is perhaps a good example of the difficulties of cost analysis at the initial stage and the implications of incorrect forecasts. Two statements must be made at the outset. First, the only available published data relate to the initial cost estimate. While subsequent costs-and-utilization evidence will be cited, this is unpublished. However there is no reason to doubt its broad accuracy. Second and most important, while the initial PLATO estimates underestimated cost and overestimated demand there is no suggestion whatsoever that this was not a best estimate at the time. The PLATO data are included because they are of intrinsic interest and because they illustrate very clearly the problems of cost-and-demand estimating at the initial stage.

PLATO

PLATO (Programmed Logic for Automatic Teaching Operations) is an attempt to provide a complex and sophisticated computer-based education system. It began in 1959 at the University of Illinois and after a number of developments, the latest model is PLATO IV.

The versatility of PLATO IV is explained by Alpert and Bitzer (1970). In this system the computer is not programmed to accept a simple correct answer. It uses an algorithmic approach to respond to student answers. The computer can be programmed to distinguish between an incorrect or nonsense answer and a spelling mistake and is also able to respond to unpredicted behaviour.

Thus Alpert and Bitzer argue that

> teaching strategies which do not call for specified student responses are widely used. . . . For example geometry students may be called upon to 'draw' on the PLATO graphic display a figure that has specified geometrical properties but need not be of a particular size or in any given location on the screen.

Alpert and Bitzer further argue that computer-based instruction can develop critical thinking and analytical skills. They cite an example of an 'inquiry' mode of instruction where the student is confronted with a problem which cannot be answered by multiple choice. He or she may need to ask the computer some questions or ask it to perform various tests or to provide information necessary for solving the problem. The computer can respond to these requests, query their relevance, suggest further avenues for inquiry and assess the final result. Further examples of the use of PLATO IV are to be found in Bitzer, Sherwood and Tenczar (1973).

The core of the PLATO IV system is the central computer which provides the logic, rapid-access memory and main date-processing facility for the system. The tasks required of it ensure the need for a very powerful (and expensive) computer. Linked to it is a software system for organizing various teaching, testing or research strategies and for specifying the language in which directions to the computer are to be formulated.

The individual student terminal through which the student works has a keyset which the student uses to respond to questions from the computer and to give instructions and also a plasma display panel on which questions, instructions and visual images are shown. A distribution channel is required for carrying information between the computer and individual student terminals. Numerous alternative models are available and indeed these have different cost implications (see Ball and Jamison, 1973). The optimum system depends on the number of terminals to be connected and the length and geographical nature of their dispersion. The PLATO system uses coaxial (television) lines from the central computer to various distribution centres and telephone lines from these centres to individual terminals.

These three items, computer hardware and software, student terminal, and distribution channel, constitute the core of a computer-based education system. In addition, when costs are considered the management and instruction costs should be included. The components of the PLATO system are the hardware by which the interaction of education takes place. The costs of producing the content of that education and its management without which the hardware would be irrelevant must also be considered.

In their analysis of PLATO IV costs, Alpert and Bitzer calculated that the operational costs of the system would amount to \$0.68 per student contact hour with a further \$0.35 per student contact hour for instructional cost (i.e. authors and supportive services salaries plus materials, etc.). Thus the total cost per student contact hour was estimated to be about \$1. It is assumed that these costs are in 1969 prices although no explicit statement to this effect was made.

Latest estimates of PLATO IV costs per student contact hour are nearer to \$5. A small part of this might be explained by the rise in prices since 1969. However, some of the items of cost, for example the central computer, would not be affected by this factor. Part of the reason is an underestimation of costs on certain items, particularly communication and curriculum costs. As indicated previously, communication costs depend on the distance of the terminal from the central computer. PLATO IV has not been able to develop the communication system envisaged by Alpert and Bitzer and the alternatives are much more expensive. A leased line in the United States cost in the region of \$9 per annum per mile in the mid 1970s, implying a large communication cost for terminals some distance from the centre.

On curriculum costs, Alpert and Bitzer assumed that the instruc-

tional cost of preparing one hour's worth of material would amount to about $600 on average. (They assumed that each hour's worth of material would be used by 500 students for five years, producing the instructional cost per student contact hour of $0.25 referred to above.) We shall discuss the utilization factor later. Observers of the PLATO IV system now believe this to be a serious underestimate although it is difficult to give a precise figure. It seems generally agreed, however, that the time, effort and cost required to produce an hour's instructional material is much greater than originally estimated.

These cost underestimates, while important, would have had less effect on the per-student-contact-hour figure if the utilization rates envisaged originally had been realized. It is the overestimation of student usage which is the main cause of the difference between original estimates and actual figures. Alpert and Bitzer assumed that the system would incorporate over 4,000 terminals each of which would be used by students for an average of 2,000 hours per year (45 weeks at 44 hours per week) producing an annual number of 8.2 million student contact hours.

However, the position now looks very different. It is generally accepted that the system is unlikely to be able to handle more than a maximum of 1,000 students at any one time. Allowing for the need for some spare capacity, the maximum number of terminals installed is unlikely to be above 1,250. The evidence on average terminal use is scanty and estimates range from 1,200 hours to 2,000 hours. Thus even if the maximum possible usage was to be achieved, this would produce 2.5 million student contact hours rather than the 8.2 million previously forecast. Thus the non-achievement of the student contact target has the effect of raising the average cost by a factor of more than 3. It should also be noted that the figure of 2.5 million student contact hours is the new estimated maximum. Present utilization rates are below even this revised target.

All this of course needs to be put into perspective. A costs study of the PLATO system is useful as an example of the effects of wrongly estimating costs and utilization rates at the outset of a project. It may well be that the likely average cost per student-contact-hour figure of $5, while five to six times higher than the original figure, still makes the PLATO IV system attractive compared to other instructional systems, including the live lecture. This may be particularly the case when some of the educational benefits of PLATO IV as outlined earlier are considered.

Moreover PLATO IV is a good example of the cost advantages of developing a system to the full potential once it has been established. Most of the major cost items such as the central computing facility are now fixed. There are no extra curriculum costs to the wider use of existing programmes. Hence, the marginal costs of using an existing student terminal to follow an existing course are very small, and this

would be the lowest cost method of increasing utilization. Increasing the number of terminals would, of course, incur extra terminal and communication costs but average costs would still fall even if each extra terminal was used for only 400 hours a year which amounts to between 10 and 12 hours a week during term time.

Decisions relating to a system in use

A media system in use requires a large number of planning decisions on a regular basis. This includes relatively straightforward decisions on future student numbers, financial resources, etc., as well as more complex decisions about changes in media mix, subject mix, and so on. It is here that cost analysis can provide the necessary information. The cost methodologies introduced in Volume 1 of *The Economics of New Educational Media* are particularly appropriate.

In this publication, Orivel reports on meetings of experts to clarify the methodological problems involved in cost analyses. One general point that emerges is the benefit to be derived from dividing costs into those that are fixed in relation to a particular measure of output and those that vary as the output varies, thus enabling the cost implications of changing output or utilization to be accurately assessed.

A more sophisticated analysis allocates costs to the different areas of the system. Thus a media system is likely to involve conception and production costs, duplication and distribution costs and presentation and operational costs. By identifying the costs that fall into each category and relating them to the particular output relevant to that category, more useful information for decision-makers can be provided.

The two studies chosen—the Open University and Colorado State University—exemplify this approach. The Open University is, of course, of wider interest as probably the most sophisticated media system in use in higher education. However, it should be remembered that we cannot look to the Open University for an example of the use of cost or effectiveness analysis in the initial decision. It is clear from the accounts of Scupham in MacKenzie *et al.* (1975), MacArthur (1974), the white paper outlining the United Kingdom Government's policy in 1966 and the report of the planning committee in 1969, that no detailed analytical costs or demand estimates were available. In the words of Scupham, 'the decision to go ahead . . . was a political act of faith' (MacKenzie *et al.*, 1975, p. 327). The relatively large amount of material now available on the Open University deals with the university as a going concern.

The Open University

The United Kingdom Open University is probably the largest and most sophisticated application of educational technology to higher education. Established in 1969, and taking its first students in 1971, by 1976 it was incurring an annual recurrent expenditure of some £26 million on a total student population of about 50,000.

Many aspects of the Open University have attracted attention. Some are interested in the fact that it caters for mature students, allowing those over 21 years of age a second or, in reality, a first chance to experience higher education. Others are interested in the open admissions policy with no academic prerequisites laid down for entry.

The major focus of attention, however, has been on the technology or learning system which the Open University has adopted to enable it to meet its educational objective of providing part-time higher education to unqualified mature students. This objective required the establishment of a distance-learning system which consists of five main components: correspondence materials, television and radio programmes, class tuition at local study centres and summer schools.

The correspondence materials are at the centre of the learning system, taking up the largest proportion of staff time in preparation and student time in learning. For each course, a package of materials is sent to students regularly throughout the year. This package contains a high-quality course unit text for home study during the prescribed period as well as supplementary notes offering guidance to the reading of set textbooks, possible additional readings, introductory notes to the scheduled radio and television programmes for that period, self-assessment questions to enable students to monitor their progress during their reading of the course material, and assessment questions, both of multiple-choice and essay type, to be sent away for marking and which count towards the student's final grade. In addition, students on science- and technology-oriented courses also receive home experimental kits which, as the name implies, include materials and equipment enabling students to carry out relevant experiments in their home.[1]

The radio and television programmes are perhaps the most glamorous aspect of the Open University in that they are transmitted over British Broadcasting Corporation national networks and are thus available to any viewer. However, they form only a small part of the teaching package with most full credit courses consisting of between eleven to sixteen twenty-five minute television programmes and the same number of twenty-minute radio programmes. As students are scheduled to spend about 360 hours a year on a full credit course, even assuming that each

1. The term 'kit' is an elastic one and the package might include records, tapes, slides, etc. for the student's home use.

programme is watched twice means that only twenty-four of these hours (about 7 per cent) are spent watching the programme.

The face-to-face tuition is also a small part of the total system and varies between courses. Its purpose is to provide both personal and academic support to students in their own particular locality through the provision of part-time tutors, usually academics from other institutions, using the facilities of local colleges in the evenings and at week-ends. The maximum personal tuition help is provided on foundation courses and amounts to about one to two hours a week. On other courses, personal tuition amounts to between ten to sixteen hours spread over the year.

The summer-school facility is another aspect of personal tuition but this time concentrated in a week's intensive study on a conventional university campus during the summer months. Not all courses have summer sessions, the emphasis being on all foundation courses, science and technology courses requiring intensive experimental sessions and arts courses requiring student interaction and participation.

The university is divided into six faculties: arts, social sciences, education, mathematics, science and technology. Each faculty except education has a foundation course and a range of second-, third- and fourth-level courses divided into half or full credits.[1] To obtain an ordinary degree a student must obtain six credits including two at foundation level. An honours degree requires eight credits, of which at least two must be obtained at third or fourth level. Students with previous qualifications are given credit exemptions up to a maximum of three for students with a previous degree.

This teaching system results in a high fixed cost in relation to student numbers. Virtually all the costs of television and radio programmes are incurred irrespective of the number of students. The same holds for the correspondence material where the major academic staff costs of preparation are fixed and only the actual printing costs vary with student numbers. Even as regards the latter, a proportion of printing costs, the setting of type for example, is also fixed.

In a major study of early Open University costs, Laidlaw and Layard (1974) produced two cost functions to cover those costs which might be allocated to the production of courses and those which might be regarded as central university costs. Within these two categories the cost function distinguished between fixed and variable costs as follows: (a) fixed course costs, i.e. costs which are inescapable if a course is instituted; (b) variable course costs, i.e. costs which can be altered by altering the number of students in a course; (c) fixed university costs, i.e. costs which are inescapable if the university is in existence; and (d) variable university costs, i.e. costs which can be altered by altering the number of students in the university.

1. Some science courses are divided into one-third and one-sixth credits to enable different courses to be combined into a half or full credit.

Laidlaw and Layard allocated all costs in 1972 to one of these four headings and compared the figures with those obtained for conventional universities in the United Kingdom. For central university costs they found that the Open University costs function in pounds (1971 prices) was:

$$\text{TCUC} = 1{,}584{,}247 + 44n$$

while for a conventional university the function was

$$\text{TCUC} = 130{,}935 + 111n$$

where n is the number of students and TCUC is total central university costs.

The functions for course costs were separately calculated for each course then in production and the results are shown in Table 1. While the Open University figures are calculated separately for each course, the conventional-university figures are only available for the subject area as a whole. Nevertheless the data in the first four columns of the table show clearly how in all the courses bar one, the Open University has a higher fixed cost and lower variable cost than the campus university.

Although the data must be treated with circumspection, they do yield some interesting results. By comparing the two cost functions for different levels of student numbers, Laidlaw and Layard calculate the break-even number, i.e. that number of students above which total costs at the Open University are lower. For central university costs the break-even number of students is 21,691 while the figures for courses costs are shown in column 5 of Table 1 with actual course numbers in 1972 shown in column 6. The figures show that with the 31,000 students enrolled in 1972 the Open University reaps significant economies of scale on central costs but that on about half of the courses conventional course costs are lower. By 1976, with 50,000 students enrolled the economies of scale on central costs was substantial. However, because of the increase in courses as student numbers rose, it is doubtful if the situation as regards course costs has changed significantly. Nevertheless overall the Open University, by having such high student numbers, is able to spread its fixed costs sufficiently to produce what Wagner (1977) calculates to be about a 4 : 1 advantage over conventional universities in the average recurrent cost per undergraduate. In other words, Open University average costs are a quarter of those of conventional universities.

In his 1977 paper, Wagner updates some earlier calculations he made comparing the Open University and conventional universities. Besides the average costs calculation just referred to, he also calculates on the basis of experience of students failing to complete a course that the average cost per honours graduate at the Open University is likely to be about half that of a graduate of a conventional university. However, Wagner also takes opportunity costs into account in his calculations. An important element here is the part-time nature of Open University

Table 1. Open University course costs and those in campus universities (1971 £)

Open University courses	Open University courses: Overhead per full-credit course (1)	Open University courses: Variable cost per student full-credit course (2)	Campus university departments	Campus courses: Overhead per full-credit course (3)	Campus courses: Variable cost per student full-credit course (4)	Break-even number of students per annum (5)	Actual Open University students 1972 (6)
A100	162,558	56	Arts	401	117	2,658	5,399
D100	147,579	51	Social science	671	87	4,080	6,586
M100	168,859	57	Mathematics	671	88	5,425	3,803
S100	181,158	89	Physics/biology	666	218	1,398	3,596
T100	147,488	78	Engineering	673	223	1,013	3,354
A201	78,081	28	Arts	401	117	872	1,623
A202	80,305	26	Arts	401	117	878	1,711
D203	72,590	33	Social science	671	87	1,332	1,064
M201	108,442	56	Mathematics	671	88	3,367	1,448
D281	73,702	109	Social science	671	87		283
D282	66,858	46	Social science	671	87	1,614	430
D283	70,356	32	Social science	671	87	1,267	1,684
E281	83,378	31	Social science	671	87	1,477	3,680
E282	84,966	28	Social science	671	87	1,429	2,596
E283	78,016	32	Social science	671	87	1,406	3,030
MST281	106,622	57	Mathematics	671	88	3,417	747
MST	104,856	38	Mathematics	671	88	2,084	913
SDT286	109,314	70	Physics/biology	666	218	734	1,634
TS282	115,786	158	Engineering	673	223	1,770	1,232
S22–	95,007	100	Physics/biology	666	218	800	636
S23–	116,889	101	Physics/biology	666	218	993	533
S24–	100,146	138	Physics/biology	666	218	1,244	389
S25–	98,070	180	Physics/biology	666	218	2,563	229
S2–1	110,490	95	Physics/biology	666	218	893	556
S2–2	122,742	78	Physics/biology	666	218	872	448
S2–3	151,638	57	Physics/biology	666	218	938	763

students which allows them to continue working while studying. Most conventional university students in contrast are full time and society loses the output they could be producing while studying. If these opportunity or resource cost differences are taken into account, then the average cost per undergraduate difference between the two systems is in the region of 7 : 1 in the Open University's favour. A summary of Wagner's 1977 figures is provided in Table 2.

TABLE 2. Open University and conventional universities revised average costs 1973 (1971 £)

	Open University	Conventional university
A. Average recurrent cost per equivalent undergraduate	258	960
B. Average recurrent cost including imputed rental cost of capital per equivalent undergraduate	272	1,111
C. Average recurrent cost per graduate	2,719 in 1973 1,842 in the long run	4,049–4,801
D. Resource cost per equivalent undergraduate	272 minimum	1,647–1,947

While these results are of interest, they are of only limited value as they depend on the actual conditions of operation of the Open University in the United Kingdom. They do not offer much guidance about the operation of the university under different conditions or circumstances. However, as a major part of his 1977 paper, Wagner builds on the approach of Laidlaw and Layard in establishing a cost function that enables the implications of alternative developments to be spelt out.

The cost function attempts a simple disaggregation of the output variables. It identifies three main outputs or activities that give rise to additional costs. These are the production of new courses, the maintenance of existing courses and the enrolment of students. The output variables are interdependent only in the sense that a new course in year t will mean an additional course to be maintained from year $t + 1$ onwards. Otherwise it is possible to increase student numbers without increasing the number of new and maintained courses and vice versa. Thus the cost function reads

$$TC = a + bCn + xCm + ySn$$

where TC = Total costs
Cn = Number of new courses
Cm = Number of maintained courses
Sn = Number of students
a = Fixed costs
b, x and y = Appropriate coefficients of Cn, Cm and Sn.

This function can now be used to assess the cost implications of alternative policies. For example, in 1976 the Open University was maintaining some fifty-five full-credit equivalent courses for the benefit of some 50,000 students. Costs in future years will be determined by how many new courses are produced and how many new students are enrolled. It is necessary therefore to estimate the marginal costs b, x and y of respectively putting on a new course, maintaining a course and enrolling a new student, all other costs being regarded as fixed.

Based on an investigation of Open University costs, Wagner estimates that the appropriate coefficients in 1976 pounds are

$$TC = 19{,}824{,}000 + 436{,}000\ Cn + 44{,}000\ Cm + 200\ Sn.$$

In other words, it is estimated that each new course costs £436,000 to produce, each existing course costs £44,000 to maintain and each new student costs £200 per annum, all other costs amounting to £19,824,000.

Starting from this base is is possible to predict future Open University costs in the light of known plans[1] as well as analyse the effect of alternative assumptions. Table 3 provides Open University plans in 1976 up to 1979. It will be noted that not all new courses add to the number of courses which require maintaining in subsequent years as some of these new courses may simply be replacing existing courses.

TABLE 3. Open University Plans, 1976–79

Year	New courses produced	Net new courses[1]	Courses maintained	Student numbers
1976			55.16	50,994
1977	9	7.5	62.16	56,550
1978	13	9.5	72.16	60,500
1979	12	5	77.16	62,500
	12	4		

1. Not including those replacing existing courses.

The results of these assumptions are shown in Table 4 and the main conclusion is that little reduction in average costs is expected from the 1976 level of about £500 per student in the period to 1979. The economy of scale reaped by the university in the earlier years as shown by the 4 : 1 average cost per student advantage has now stopped and it seems to be following the conventional university pattern of little increase in productivity.

One reason for this is that the increase in student numbers has slowed down. On the other hand, it may well be that a figure of about

1. These were plans in existence in 1976 and may have changed now. Nevertheless, the methodology involved is useful as an example of how cost analysis can aid planning.

TABLE 4. Open University average cost per student, 1976–79 (1976 £ thousands)

Year	Fixed cost	New course costs	Maintained course costs	New student costs	Total costs	Average cost per student
1976	19,824	3,924	2,427	—	26,200	0.513
1977	19,824	5,668	2,757	1,111	29,400	0.520
1978	19,824	5,232	3,175	1,901	30,100	0.498
1979	19,824	5,232	3,395	2,301	30,800	0.493

65,000 students is the maximum the present system of production and administration can handle and any increase above this figure would require radical reorganization and a rise in the element of cost at present regarded as fixed. Moreover, at the 1979 level of expenditure for course production and maintenance, student numbers would have to rise to nearly 90,000 to bring average costs down to £400 per annum.

The main reason that average costs show little reduction since 1976 (and indeed since 1973) is that the Open University has been using the economies produced by rising student numbers to increase the number of courses offered rather than to reduce average costs. However, as the increase in student numbers flattens out in the latter part of the decade, the scope for using economies in this way is limited. As Table 3 indicates, the number of net new courses added to the programme is planned to fall significantly in 1978 and 1979.

The cost function shows, in fact, how average costs could be reduced simply by increasing student numbers without increasing the number of new courses. If, in 1979, the planned number of students were presented with the 1976 number of new and maintained courses, average costs would be reduced to about £450 per student.

One limitation of the cost function is that the data are based on existing policies. In the latter part of his paper, however, Wagner considers the adoption of the function to study the effects of alternative policies. One alternative is to change the mix between different faculties giving greater emphasis to subjects with lower marginal costs in production and maintenance. For example, while the average cost of producing a new course in the university as a whole is £436,000, the cost in different faculties varies from £340,000 in arts to £598,000 in science. In addition, science and technology students impose higher costs in the student-related areas because of home experimental kits and summer schools.

Thus in broad terms every switch from science and technology to arts and social science courses is estimated to save the university at least £200,000 in new course production costs, £20,000 in maintenance costs, and about £60 per student per annum for every student taking the course. Wagner estimates that if all courses in 1976 had been in arts

and social sciences, average costs in that year would have been £426 per student and not £493, producing a saving on total expenditure of some £3.5 million.

Another way to reduce costs is to change the components of the university's teaching system. For example, Wagner calculates that if all broadcasting were removed, fixed costs would be reduced by £2 million, or nearly 30 per cent, and costs per course by £115,000 per new course and £11,500 per maintained course, a fall of some 25 per cent. If there had been no broadcasting in 1976, the average cost per student would have been £440.[1] Alternative options are available such as a reduction in part-time tutoring or summer school attendance or a lowering of the quality of printing and presentation of the course materials. It is a legitimate argument against these options, however, that they would change the nature of the product offered to the students and clearly an Open University operating under such circumstances would be different from the present one.

However, this indicates that the actual average cost-per-student figure at the Open University is a consequence of decisions taken early in the university's life concerning the mix of the teaching components and offers little guidance on the cost effects of alternative Open University type systems in different circumstances. An Open University type technology can be made more or less expensive than the amount resulting from the particular production components of the existing Open University. Increasing the number of courses, broadcast programmes and hours of part-time tuition will raise costs. Reducing these elements will cause costs to fall. Thus the costs of an Open University media mix system can fall within a wide band of upper and lower limits.

The value of cost functions as shown here is that they can help decision-makers in the institution itself to see the cost implications of alternative policies. Moreover, they indicate to outside observers not just the final answers on cost comparisons but, much more valuably, the structure of costs which produces these final answers.

Much of the writing on the effectiveness of the Open University has been concerned with achievements such as attracting working-class students, differential survival rates of different categories of student, utilization of broadcasting, and so on. This information is impossible to summarize in a paper of this nature and the interested reader is referred to McIntosh, Calder and Swift (1976). Other useful information will be found in Tunstall (1974), Bates (1975).

The information on educational standards is more subjective but still interesting. In general, the Open University has sought to maintain

1. This is a drastic option. A more realistic approach is to investigate those high-cost areas of broadcasting for which alternative technologies might be substituted. The Open University is in fact doing this and those interested in the findings should consult Bates and Kern (1977).

similar academic standards to other higher education institutions through rigorous external assessment of their teaching materials together with the usual external examiner provisions. An increasing number of universities are now willing to give exemptions to Open University students for credits earned and the Central Council for National Academic Awards has agreed national transfer arrangements between the Open University and Polytechnics. Many universities also now accept first- and upper-second-class honours Open University graduates for post-graduate work.

There is thus firm evidence of recognition by the higher education system that the Open University academic standards are equal to those of other institutions. However, an objective measure is not yet available. The Esmee Fairbairn Economics Research Centre at Heriot Watt University in Edinburgh in conjunction with the Open University has been carrying out an experiment which will shortly yield results. The experiment carried out at United Kingdom universities and reported in Attiyeh and Lumsden (1971) has now been extended to the Open University. In this experiment, all first-year students of economics are given a series of multiple-choice objective questions both before and after their course. The resulting change in performance is standardized to allow for various student characteristics so as to enable some measure of learning gain due to the course itself to be established. The interim results seem to confirm the academic effectiveness of the Open University. Further information can be obtained from the Esmee Fairbairn Economics Research Centre.

SURGE at Colorado State University

SURGE[1] stands for State University Resources for Graduate Education and was established in 1967 by the College of Engineering of Colorado State University in the United States to provide graduate-level work to employees of various corporations in the state of Colorado without the necessity of their attending the campus of the university. The system expanded and by 1972/73 the university offered master degree programmes in Civil, Electrical, Mechanical and Industrial Engineering, and Business Administration as well as individual courses in mathematics, statistics, atmospheric science, psychology and watershed science. In that year, eighty different courses were offered and these were taken by 1,277 off-campus students from thirty-four different industrial and governmental organizations.

The SURGE programme makes available to off-campus students courses which are already in existence for campus students. This is done by video-taping a lecture plus any classroom discussion in a specially

1. For further discussion of SURGE, see Baldwin (1969), Baldwin and Neidt (1970), Baldwin *et al.* (1972) and Wagner (1975).

equipped studio classroom. The tape is packaged with class materials, assignments and examinations and collected by a commercial delivery service on the evening of the same day. It is then delivered to the appropriate industrial location where it is usually viewed by off-campus students within forty-eight hours of the original lecture. During the viewing session, a graduate student is usually on call at the university to deal with any telephone queries students may have as they watch the material. The tapes can be held for a second viewing but eventually they are returned to the university where they are wiped and used to record subsequent lectures. Personal contact with students is maintained by regular staff visits to their location.

SURGE students have to complete the same assignments, reports and examinations as on-campus students. If there is any laboratory work, they use the facilities of their employer. When specialized reading is required, the article is photocopied and sent to each student. SURGE students receive the same certificate and notation as campus students and no distinction is made between them in the records.

The participating organizations provide the classroom facilities, play-back equipment and administrative support for the programme free of charge to the university. All parties benefit from this arrangement. The university has certain costs of the project met from outside its own budget while the project as a whole provides an additional source of demand. The participating organizations obtain in-service training and better qualifications for their employees at a lower cost than if they had to attend on campus, while the students themselves obtain these qualifications without having to give up their employment to attend full time or travel large distances to study part time.

In analysing the costs of the SURGE system, Wagner (1975) produced disaggregated cost functions which enabled the effect of changing different variables in the system to be assessed. The total cost of the programme in any one year is made up of the cost of recording lectures, duplicating and distributing them and providing student services and support at each location. Hence,

$$TC = f(RDS)$$

where TC = Total costs
R = Recording costs
D = Duplicating costs
S = Servicing costs.

Recording costs have a large fixed element in that the studio-classroom and supporting staff are required even if only one hour's worth of material is recorded per annum. These costs will not vary as the classroom is more heavily utilized until a certain maximum number of hours is reached, when a new studio-classroom will be required. In addition, there are variable costs directly related to each hour's worth of recording.

Duplicating and distribution costs depend on the number of locations

to which each hour's worth of course material has to be sent. Each location requires a separate recording because the speed of the operation does not allow time for copies to be made from the master tape. So a sufficient number of recording machines must be available to cover the number of locations each course is likely to be sent to. The cost of the recording machines is, however, fixed in relation to the number of recording hours. The other costs such as distribution depend on both the number of locations (or tapes required) and the number of hours of course material produced per annum.

Finally, there are servicing costs. These consist of faculty visits to students, which depend on the number of locations per course and course hours and the cost of graduate instructors' help in being available for personal calls from off-campus locations while the students are watching the material. These, together with secretarial and other minor student support expenses, can be viewed as fixed costs for each course hour.

These separate production, duplication, and distribution, and servicing cost functions can be brought together to calculate an overall average cost per student contact hour. In 1972/73, there were 2,790 hours of recorded material, the maximum number of locations for any one course and therefore the maximum number of recording machines required was 11, the average number of locations per course was 2.92 and the average number of students per course was 12.11. Applying these figures to the average cost function, Wagner calculated an average cost per student contact hour of $5.64 in 1972 prices.

The value of disaggregating the cost function, however, is that it enables the effect of changing key variables to be traced. For example, the three studio-classrooms could be used more intensively and the effect on average costs measured by using the recording costs function. Wagner shows that increasing utilization from 2,790 hours to 3,600 hours per annum which implies each classroom being used for thirty hours a week for forty weeks a year would not significantly affect the overall figure. If nothing else changed, such a move would reduce average cost-per-student contact hour by about $0.60.

Of greater significance are changes in the average number of students per course and average number of locations per course, as shown in Table 5. While the actual average cost per student hour of $5.64 already shows the benefits of economies of scale compared with what it might be if the system was severely under-utilized, it is clear that further reductions in average cost would still be possible. Indeed, if one extra location could be found for each course, even if this resulted in only one extra student per course, then average costs would fall. For example, with three locations and twelve students, average cost is $5.72. With four locations and thirteen students, average costs fall to $5.63.

There is little to say on the effectiveness side. The only evidence available is that off-campus students on average produce the same level of performance in course work and final examinations as campus students.

TABLE 5. Effect of varying student numbers per course and location per course

Students per course	Locations per course					
	1	2	2.92[1]	3	4	5
1	59.78	64.23	68.32	68.68	73.13	77.58
2	29.89	32.12	34.16	34.34	36.57	38.79
3	19.92	21.41	22.77	22.89	24.38	25.86
4	14.95	16.06	17.08	17.17	18.28	19.40
5	11.96	12.85	13.66	13.74	14.63	15.52
6	9.96	10.71	11.39	11.45	12.19	12.93
7	8.54	9.18	9.76	9.81	10.45	11.08
8	7.47	8.03	8.54	8.59	9.14	9.70
9	6.64	7.14	7.59	7.63	8.13	8.62
10	5.98	6.42	6.83	6.87	7.31	7.76
11	5.43	5.84	6.21	6.24	6.65	7.05
12	4.98	5.35	5.69	5.72	6.09	6.47
12.11[1]	4.94	5.30	5.64[1]	5.67	6.04	6.41
13	4.60	4.94	5.26	5.28	5.63	5.97
14	4.27	4.59	4.88	4.91	5.22	5.54
15	3.99	4.28	4.55	4.58	4.88	5.17
16	3.74	4.01	4.27	4.29	4.57	4.85
17	3.52	3.78	4.02	4.04	4.30	4.56
18	3.32	3.57	2.80	3.82	4.06	4.31

1. Actual numbers in 1972/73.

Who benefits?

In industry, the benefits yielded through new technology are usually distributed between those involved in the product. Thus, if new machinery enables a greater output per unit of input, this overall benefit may be split three ways. The capitalist who has provided the funds will take a share in the form of increased profits. The workers who have had to change working methods and possibly reduce their number will take a share in the form of increased wages. And the consumer, if he or she is lucky and there is anything left over, will benefit through reduced prices or an improved product.

In education, a similar situation exists. Given that the introduction of technology reduces costs, how is this to be apportioned? There is the funding body the academic staff and the students, all with claims to benefit. In view of the delicate political issues involved in such a decision, it is not surprising that no published study on this subject is available. However, in a study of the Stanford Television Service, Jamison and Lumsden (1975) show how costs analysis enables the various options to be spelt out.

Jamison and Lumsden use a model which takes faculty time as fixed. Given this constraint, they seek to establish trade-offs between various options open to an institution as a result of the introduction of new technology. These take the form of an increase in faculty research time, the number of courses or the number of students. In other words, if new technology enables more to be produced from a given input, this can be distributed in a number of ways. The administration might favour more students being taught for the same cost, thus producing greater fee income; the students might favour more courses being made available to give them more choice; while the faculty might favour student and course numbers remaining constant with the benefit being received by them in the form of less teaching and more research and consultancy time.

Jamison and Lumsden apply their model to the introduction of instructional television (ITV) into the MBA-degree courses at the Stanford Graduate School of Business. They divide the cost of producing one course by this method into the initial cost of producing the course and the annual costs of using it. They allow for an element of personal tuition on ITV course and for a 15 per cent revision factor each year both of which will incur annual costs. Their calculation does not take into account the initial cost of producing the programme but concentrates on the benefits in future years of replacing a live course by the initial television course. The justification for this omission is that the extra cost of simply televising the live lectures given in any one year is quite small, particularly when it is amortized by subsequent use over a number of years.

In 1971/72, there were 597 MBA-degree students enrolled at Stanford and 82 courses offered. Using their model Jamison and Lumsden show that if the eight most heavily attended courses were taught by ITV within the same cost constraint MBA enrolment could be increased to 750 with the resource equivalent of five full-time staff members being available for increased research and/or increased course provision. They further point out that the initial costs of producing the programmes would be recouped if only 40 of the additional 150 students materialized.

Jamison and Lumsden do not provide information on the particular decision on trade-offs taken in this case. However, the Stanford experiment and their paper offer a good example of how cost analysis can be used to indicate the option available.

Their paper also deals with the effectiveness side in providing an evaluation of student learning on one of the courses taught by instructional television. This was the micro-economics course taken by 150 students. Students had the alternative of attending the live lecture, simultaneously viewing the lecture on television in overflow rooms or watching video-tape replays of the lecture at a different time during the week. Students could also meet a lecturer in a small discussion group once a week. All the students attended some of the live lectures, with 59.6 per

cent attending all the lectures, 43.8 per cent never viewing lectures on live television and 58.4 per cent never viewing the video-tape replays.

Numerous tests were used to measure student performance over the course. An objective test was given near the beginning of the course after they had read a programmed text, course work was handed in, and they received final examination scores. Using regression analysis, a number of interesting results emerge and are described in Jamison and Lumsden (1975). The major point relating to media is that 'all methods of presentation of the lectures appeared to be equally effective in terms of learning economics'.

Student attitudes to using media were also tested; 68.5 per cent of the class opted for the instructional television approach rather than the conventional teaching method of other courses and this course in previous years.

Conclusions

It has only been possible to review a small number of economic studies on the use of media for distance learning at the post-secondary level. There are now a significant number of such systems but many are of recent origin and have not been in operation long enough to generate useful studies. In other cases, studies have been mainly for internal purposes and the data produced are not suitable for comparative purposes. This situation should improve over the next few years as systems become more firmly established. However, it may be necessary for institutions and the international agencies which sponsor them to encourage such evaluative studies and to ensure their independence.

Even from the limited number of studies available, it is possible to draw some conclusions. The following come to mind:

While there are common features of all media systems, post-secondary education has some specific characteristics that require separate costs-and-effectiveness analysis.

On the cost side, utilization is a crucial variable for both initial and ongoing decisions. In any analysis, the utilization estimates should be most carefully scrutinized. Where possible, sensitivity analysis should be used to measure the effect of different utilization estimates.

While cost estimates are an essential requirement for an initial decision about media use, cost analysis is most powerful in decisions about systems already in use. The structure of cost functions and their distinction between fixed and variable costs makes them very suitable for analysing the cost effects of various alternative courses of action.

Insufficient attention has been paid to the distribution of benefits arising from costs saving attributable to the use of media. This is a management problem for educational technology similar to the problems

facing industrial management on the introduction of industrial technology. The general lessons of the management of innovation should be applied to educational innovation and this is an area where further study should be encouraged.

A major gap exists in the area of effectiveness studies of media use in higher education. Most studies assume a similar standard or level of achievement between media and conventional technology but very few provide objective evidence to support this assumption. While subjective evidence is admissible and strongly supports the assumption, more objective evidence would be welcome.

It is difficult to generalize about the cost effects of using media in higher education. The media mix of systems is different, the utilization rates which are very important are different, and the time scales are different. Systems cannot be picked off the shelf but must be specifically designed and costed to meet particular educational objectives. Given that and accurate utilization estimates, media systems in higher education can provide for a variety of educational objectives at lower average student costs than conventional systems. The value of cost-and-effectiveness analysis as reported here, however, lies not just in the results they provide but much more in the methodologies they use and the lessons to be drawn from them. These indicate that sophisticated cost analysis can provide decision-makers with the effects of alternative strategies and with insights into the structure of the system they are administering.

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Abstracts

Origin
Brazil.

Authors
OLIVEIRA, J. B.; ORIVEL, F.

Title
A Madureza Project in Brazil, Bahia State.

Bibliographical description
PERRATON, H. (ed.). Distance teaching for formal education: what the projects tell us about cost and effects. Washington, D.C., World Bank, September 1978. (Mimeo. Prepared by International Extension College for the World Bank.)

Subject analysis
Educational Radio Broadcasting's radio programmes for adults out of school preparing primary school examinations.

Contents analysis
The Educational Radio Broadcasting Institute (IRDEB) of the state of Bahia in north-east Brazil was set up in 1969 to co-ordinate educational broadcasting in the state. Since 1969 it has offered courses on the radio for the first-cycle *madureza* examination, equivalent to the level of the final four years of primary school. IRDEB has also been involved in a number of other distance-teaching programmes but the largest, in terms of student enrolment, has been for the *madureza*, with enrolment rising to some 8,000 students in 1977. The IRDEB *madureza* programme has been parallel to, but separate from, the federal Minerva project which has not been available to students in Bahia. The decision to run the project at a state level meant that it was possible

to relate the teaching material more closely to the state-set *madureza* examination.

IRDEB students receive radio programmes, which are broadcast between 8 and 8.30 p.m. daily, and printed texts which support and relate to the broadcasts. Some students listen at home—and inevitably there are no figures to show how many *madureza* students prepare themselves for the examination informally in this way—but others attend a listening centre where they follow the broadcasts under the guidance of a monitor. The number of centres has risen from 100 in 1973 to 208 in 1977. The monitor's role is to act as group leader and he is provided with a manual giving guidance on how to run the class and answers to the questions posed in the students' textbook. The courses are prepared at IRDEB, with subject teams preparing the radio programmes, the printed materials and the tutor's manual together. Eight IRDEB inspectors work with the teams and also supervise the work of groups in the field, although in practice they make regular visits only to groups in the two major cities. Students pay a fee of 50 cruzeiros (slightly over U.S.$3) per semester for each group of subjects; the monitors are paid at an hourly rate equivalent to the rate paid to primary school teachers in the state.

Detailed figures were not available for absentee and drop-out rates, but these were thought to be of the order of 25 per cent, taken together, and were higher in the interior than in the capital city. The national pass rate in the *madureza* examination is 33 per cent and figures for Bahia from 1973 to 1977 appear to have been 33, 37, 24 and 21 per cent, although the last two figures may be underestimated. IRDEB students in one town, generally typical of the state, achieved a pass rate of 24 per cent which is very close to the rate of 25 per cent achieved by students studying independently, or at a private establishment. The figure is half that achieved by students following courses arranged by the state using face-to-face methods and qualified teachers. From the point of view of examinations, therefore, the IRDEB system does not compare favourably with the alternative.

Similarly, the costs of IRDEB courses were compared with courses for the *madureza* offered by private establishments, revealing that IRDEB costs were some 45 per cent higher. The reason for this lies in part in the different relations between fixed and variable costs for distance teaching and orthodox, face-to-face schooling. With IRDEB's relatively high fixed costs, it would need some 100,000 students to produce unit costs similar to those of the private establishments.

Thus the scale of IRDEB's activity was such that its *madureza* programme did not look attractive economically. While there may have been strong educational reasons, which are not amenable to economic analysis, for the programme to have been run separately from the federal Minerva project, the costs of distance teaching at the level of the first-cycle *madureza* did not compare favourably with possible alternatives.

Origin
Brazil.
Authors
Oliveira, J. B.; Orivel, F.
Title
The Minerva Project in Brazil.
Bibliographical description
Perraton, H. (ed.). Distance teaching for formal education: what the projects tell us about cost and effects. Washington, D.C., World Bank, September 1978. (Mimeo. Prepared by International Extension College for the World Bank.)
Subject analysis
Federal government radio programme for adults out of school preparing primary or secondary school examinations.
Content analysis
This study is part of a series of three studies on *madureza* projects in Brazil sponsored by the World Bank. The word *madureza* refers both to a preparatory course and to an equivalence examination. The examination gives an equivalence diploma to either primary, basic or secondary school. The concept of the course and of the examination has been changed over time, but, as an institution, it was originated in the past century.

As is usual in developing countries, the Brazilian educational system is characterized by very substantial rates of drop-out, repetition and enormous inefficiencies. A cohort of students entering the first grade of primary school in 1961 would show only sixty-four of them finishing secondary school twelve years later.

Moreover, profound social transformations and major changes in the characteristics of the work market caused by a rapidly expanding economy, besides the process of urbanization, have contributed to increase the value of education and of school certification.

In the late 1960s, demand for school opportunities were increasing at a very substantial rate, and pressures were felt all over. As a part of the several governmental efforts in education and schooling, the idea of *madureza* has received a certain priority, and mass media have played a major role. As far as legislation and regulation are concerned, the government has passed a decree according to which all of the 1,100 privately owned radio and television stations in the entire country would have to allocate five hours per week of free broadcasting. Most of this period has been used for the Minerva project, both for *madureza* and for general adult education programmes.

The Minerva project starded in 1970. It encompasses the production, broadcasting and assistance for the organized reception of radio programmes, at the level of the last four grades of the eight years of fundamental education. Though Minerva is a federal programme, financed and managed by the Ministry of Education, it is only responsible for the production and delivery of the course: it was not responsible for the

organization of reception classes nor for the examinations, which are a privilege of each state, according to the legislation. However, through funds and technical assistance, Minerva has helped some states to set up their own reception systems, as well as their examination procedures.

The potential clientele for Minerva can be estimated in millions, but the actual intended clientele organized and managed by local efforts of the various states has been estimated at about 142,000 students. So far, Minerva has been repeated three times, over a period of twenty months each, and it has reached about 300,000 students under organized reception. No reliable data are available for free reception, but since the programme was simultaneously broadcast throughout the country, it is possible that many more participants have benefited from the broadcasts.

The paper describes the production, broadcasting, reception and evaluation procedures used by the project, as well as its complicated co-ordinating activities. Since states are responsible for both implementation and examinations, and since many other forms of schooling are available, very few data are available in terms of the effectiveness of Minerva, i.e.. how well Minerva students perform the *madureza* examinations. In some states, specially prepared tests for Minerva students have been used. Overall, the scarce data available are slightly favourable to the project, as compared with the national averages. However, these data cannot be interpreted as a definitive conclusion, given their doubtful origins and the aggregate nature of the national averages. There are also no background data on students.

As far as other results are concerned, Minerva has produced 500 hours of instructional material, and over 400,000 series of workbooks have been printed and distributed throughout the country. The logistics involved in distributing student workbooks and tapes to the radio stations is also quite impressive.

As far as costs are concerned some analyses were made from the data available. Specific difficulties in data collection are referred to in the paper, since the project was part of an agency which had other activities, and the budget was not separated by functions. Within these constraints, costs have been computed in terms of production, broadcasting and reception. Assumptions had to be made referring to the cost of broadcasting by the private stations. Costs have also been computed for the printed materials and general administration, both in terms of capital and expenditures. For 1977, the unit cost was estimated at 258 cruzeiros, comparing to an average of 400 cruzeiros for other types of *madureza* courses, and the latter does not include printed materials or books for the students. The very high number of students yield very attractive average costs: going from 20,000 to 100,000 students, the average cost goes down 56 per cent. It was estimated that if the system could teach 500,000 with the same cost structure, the average cost would go down only an additional 25 per cent.

Lack of data and of other studies makes it still premature to formulate judgements on Minerva's worth. It is undoubtedly a gigantic project, with unique characteristics and problems. Inefficiencies such as the utilization of 1,100 radio stations and the inadequate controls of reception are easy to detect: alternatives and solutions, within the socio-political context, are not so easy to find and implement. Issues such as centralization versus decentralization of production and implementation are also discussed, and the authors conclude the article with some general lessons which can be drawn from the project, in terms of tele-education policy-making using large-scale experiments.

This paper will be published in the forthcoming book, *The Cost of Distance Learning*, edited by Hilary Perraton, International Extension College, 131 Hills Road, Cambridge CB2 1PD, United Kingdom. A Portuguese version can be obtained from ABT, Av. Erasmo Braga, 255/401, Rio de Janeiro, RJ, Brazil.

Origin
Guatemala.
Author
ACADEMY FOR EDUCATIONAL DEVELOPMENT.
Title
Basic Village Education.
Bibliographical description
Summary based on project reports prepared by USAID for the Conference on Economic Analysis for Educational Technology Decisions.
Subject analysis
Rural Development supported by radio forums and graphic materials.
Content analysis
Present-day information needs of rural people in developing countries are not being met adequately by traditional education and extension systems. The appropriate use of modern communications technology to reinforce and extend the efforts of extensionists and teachers would appear to offer at least a partial, low-cost solution to this dilemma. The Basic Village Education Project (BVE) has been a carefully controlled experiment to study the effectiveness and relative costs of various communications media combinations utilized in such a manner.

The Basic Village Education Project comprised a carefully controlled non-formal education programme not requiring literacy and a rigorous independent evaluation of that programme's impact on knowledge, attitudes and agricultural practices among the target population. Its primary audience was the small, often illiterate, subsistence farmer; and its programme content concentrated on information to help that farmer improve his production and profits from basic crops.

The project design (as modified in 1975) included four communications media combinations as variables, with radio being a common element in three of those combinations. The variables, or treatments, were:

Treatment R (Radio). Educational messages were conveyed to the target population only through mass media, principally radio.

Treatment RM (Radio-Monitor) added interpersonal contact to mass-media delivery, achieved through a local person (monitor) employed and trained by the project to work directly with farmers in his own and three or four near-by communities.

Treatment RMA (Radio-Monitor-Agronomist), the most intensive treatment, included mass media and monitor as described above, and introduced a low level of technical agronomic assistance.

Treatment M (Monitor only), added in 1975 to ascertain the effect of the monitor apart from that of radio, utilized a monitor working in an area where the BVE radio signal was not received.

Matched experimental and control areas were established in each of the two regions specified in the implementation plan.

The BVE Educational Programme. Initiation of educational programming in the Oriente coincided with inauguration of the BVE radio station, Radio Quezada Educativa, in late March 1974, following about ten months of intensive planning and preparation. Most operational personnel were provided by the Government of Guatemala, principally the Ministry of Education which administered the project.

An integrated four-component educational programming system was instituted to facilitate the development of a quality programme. Its components—message development, educational materials production, delivery to the target population, and formative evaluation—were by no means unique to BVE. The key to the project's success in programming was the manner in which they were co-ordinated and integrated into a functional system.

Primary responsibility for agricultural message content was assigned to the BVE technical agriculture section which sought out, assessed and organized information from three kinds of sources: the people to whom the message would be directed; institutions which generate new technology and information; and institutions which provide farmers with needed goods and services. The Ministry of Agriculture was the project's primary source of technical information on agriculture, and reviewed and approved all technical content prior to its use in the BVE programme.

The project produced both materials needed in the internal programming process, and audio and graphic materials for use in delivering its message to the target audience. The production output of BVE for the Oriente included a book of technical message content with accompanying scriptwriter's guide, annual message calendars and bi-weekly message strategies for nearly three years of educational programming, more than

94,000 copies of 933 different graphic materials, and 6,872 different audio programmes of various types.

Radio Quezada Educativa broadcasts a mix of pre-recorded and live programmes (about 20 per cent was educational programming related to agriculture) to Oriente families throughout the period of the experiment. The station was on the air from Monday to Saturday on a split schedule (05.00 to 09.00 h and 16.00 to 20.00 h). It captured and maintained a large listening audience in the BVE experimental areas according to the results of periodic listener surveys.

Each BVE monitor was assigned to an area of four or five communities with 110 to 250 farm families per area depending upon community size, accessibility, and natural geographic or social limits. Nearly 1,500 weekly farmer meetings (radio forums) with a total attendance of 16,506 adults were held by Oriente monitors during the course of the experiment in addition to their contacts with individual farmers in their assigned communities.

Due to the relatively small size of the RMA treatment areas, the field agronomist worked only part time in each. Expressed on a full-time equivalence basis, he was responsible for an area having about 600 farm families. His principal functions in that area included monitor reinforcement, crop demonstrations and related activities, problem identification, and feedback. He also served as monitor trainer and supervisor, provided liaison with other agricultural programmes in the region, supplied local farm news to Radio Quezada Educativa, and participated in the development of technical message content.

A viable information feedback system was indispensable to the programme's continuing success. Various mechanisms, considered collectively as formative evaluation, were utilized: weekly feed-back reports from monitors and field agronomist; testing of newly developed programme materials; letters received by Radio Quezada Educativa (70,000 during the course of the experiment); listenership surveys; and radio signal penetration tests. In addition to helping the programme respond to the ever-changing interests and needs of its audience, such feedback contributed to the interpretation of summative evaluation results.

A small unit was established in late 1975 to concentrate on the development and field evaluation of new programme materials, particularly graphics. Its output (field-tested in both the Oriente and Occidente regions) included four picture booklets with simple tests, two poster/hand-out combinations designed for mass distribution, eight special posters and hand-outs for use in radio forums, and seven posters and sixteen flyers for distribution in the disaster zone following the 1976 earthquake.

A number of in-course modifications and adjustments was required due to administrative, operational, and agricultural/climatic factors beyond the control of the project. Delays in delivery and technical problems with equipment, budgetary delays and shortfalls on the part of the

Government of Guatemala, drought, and a disastrous earthquake were among the most important. In general, however, project operations adhered to the implementation plan throughout the course of the experiment.

An analysis of project costs, cost effectiveness and benefit/cost relationships has not yet been completed. Early approximations indicate, however, that the costs in 1975 for operation of regional programmes based on the project's R, RM, and RMA treatments (expressed on a per-farmer-reached basis) would have been \$4.34, \$21.25, and \$31.57, respectively.

Experimental programming in the Oriente region was terminated on schedule at the end of 1976. The Ministry of Education assumed complete responsibility for the BVE educational programme in that region as of January 1977, and it is continuing as an ongoing programme of that ministry.

The BVE evaluation findings. An accurate measure of the BVE impact was obtained through the continual evaluation which was a characteristic of the project. It started with a baseline study, continued with monthly time sample studies, and ended each year with an annual survey. Evaluation activities were guided by a rigorous experimental design, but also took into account social and political realities.

Joint planning of the field programme and the evaluation activities from the earliest stages of the project was a necessary factor in assuring the accuracy of results obtained. This imposed some restrictions on both programming and evaluation but allowed for continuing co-ordination. The evaluation data provided valuable information for programme initiators and feedback to keep activities on target. Thus, evaluation activities served two purposes, global impact measurement and interim programme feedback.

The BVE educational programme had a significant positive impact. The measurement of change through a total practice index consisting of twenty-nine agricultural practices revealed evidence of an overall BVE effect when treatments were compared to control.

The radio was extremely effective in bringing about changes in knowledge, in attitudes, and in behaviour. There were measurable changes in agricultural practices that were a part of the message content broadcast over BVE radio, even in the short period of time that the experimental programme was in operation. When used in combination with other sources (i.e. monitor or monitor and agronomist) in the BVE treatment areas, radio continued to be the overwhelming medium for the transmission of knowledge, attitudes and practices.

The impact of radio diminished over time. In the early stages, radio appeared to be the most important medium by which new information entered the community. It is apparent that the local communication structure (e.g. friends and neighbours) became more

important at the second stage of diffusion. Radio also showed a decrease over time when combined with other media such as monitors or visits of the agronomist which were reported as increasingly important sources.

Efforts at personalizing radio, a traditionally non-personal medium, were clearly among the most important factors in the success of BVE. The project used a unique system of personalizing the radio message programming which involved a feedback system with letters and reports by the monitors and agronomists. This type of 'open' system allowed the people themselves to develop a dialogue and assist in message development.

The monitor proved to have an important impact on change. In the area where the monitor served alone, there was evidence of rapid change in the second year of programming. When combined with radio, the monitor did not reach the level of radio as a source of new information. However, the monitor's impact increased continually whereas that of the radio declined after two years of programming.

Combining radio and monitor did not appear to increase total impact. Further investigation of community structure will be necessary before any definitive conclusions can be drawn regarding the lesser effect of the combination of radio and monitor in comparison to the monitor alone or radio alone.

The overall impact (in terms of change) was greatest in those areas in which the agronomist was used in combination with radio and monitor. The agronomist was seldom mentioned as a source of new information for change. However, examination of responses related to the question 'Where do you receive good information for your agricultural operations?' revealed frequent mention of an agronomist, including the BVE agronomist. Since many of the agronomist's activities are back-up rather than direct contact, it was not totally unexpected that the agronomist was not mentioned more often as a principal source of information for change.

Change observed in the control area is a clear indication that uncontrolled or uncontrollable factors existed in the field. Such factors had to be taken into account when measuring the differential impact of BVE in the treatment areas.

Differential treatment effectiveness was predicted but not found in the project. Differences were found that substantiated a powerful BVE effect on the experimental areas when compared to natural change in a control area, but change between different experimental areas was not consistently in favour of any one treatment.

Initially, the design was seen as composed of four discrete treatments and a control, with the treatments designed to be independent tests of different media approached. As the project evolved, however, the assumption of independence became increasingly questionable. It seems clear that the creation of a powerful message development and feedback

system resulted in the specific media delivery system being of less importance, and hence not creating change independent of the message. The agronomist and monitor were necessary for message development and feedback used in all treatments, as well as for the interpersonal contact called for in treatments M, RM, and RMA.

In summary, BVE evaluation findings indicate that radio is a highly effective change medium when used in combination with a highly developed message preparation and feedback system. A message presentation system requires feedback from content specialists in regular contact with the target population depending on content, i.e. agronomist, health specialist. Radio may be a personalized medium under appropriate conditions of content preparation.

Origin
Israel.
Authors
MELMED, A.; ELLENBOGEN, B.; JAMISON, D.; TURNIANSKY, U.
Title
Everyman University in Israel: The First Two Years.
Bibliographical description
PERRATON, H. (ed.). Distance teaching for formal education: what the projects tell us about cost and effects. Washington, D.C., World Bank, September 1978. (Mimeo. Prepared by International Extension College for the World Bank.)
Subject analysis
Distance education at post-secondary level supported by radio and television.
Content analysis
Everyman University of Israel enrolled its first students in 1976; it was modelled on the British Open University and aimed at providing both academic and vocational courses using correspondence, broadcasts, and a limited amount of face-to-face teaching. Israel is already moving towards universal education up to the age of 16 so that it was felt appropriate to use distance teaching to expand tertiary education. The university was set up mainly as a result of an initiative by an Israeli foundation which provided most of the initial money. One of its aims was to redress social imbalance within the Israeli system of higher education. Israelis from Africa and Asia are under-represented in higher education as compared with those from Europe and North America. Everyman University has no entrance qualifications and it was hoped that this would effectively widen educational opportunities for the more disadvantaged citizens.

The university offers three groups of courses: pre-academic courses, academic courses which lead to a degree, and vocational or technical

courses. In practice 80 per cent of the students enrol for the more prestigious degree courses. The same method of study is used for all three types of courses. The main burden of teaching is carried by correspondence lessons, planned by the university, but written partly by full-time university staff and partly by consultants from other universities in Israel. The correspondence lessons are supported by radio and television programmes. Students can, if they wish, work entirely by using correspondence lessons and broadcasts but study centres are also provided at which they can get tutorial help. Not every study centre can provide tutorial help for every course. Students are evaluated by a process of continuous assessment as they work through their correspondence assignments and by course examinations. Students are expected to work from twelve to fifteen hours a week. The university works on an eighteen-week cycle, with two cycles a year. Students who have successfully completed their first course may then do one or two courses in each cycle.

Everyman University enrolled 2,200 students in its first cycle of academic courses in 1976 and enrolled 6,200 in its fourth cycle. It plans to produce some 750 graduates each year but its exact relationship with the rest of the Israeli system of higher education is still to be worked out and depends on two awaited decisions. The first concerns accreditation as, at the time of writing, the degree had not yet been accredited in the same way as those of the other universities. Second, arrangements had yet to be made for government to take over financing from the Rothschild Foundation.

The university has had some success in making wider educational opportunities available to Israelis from Africa and Asia. Students born in Africa or Asia (excluding Israel) or whose fathers were born there, formed about 20 per cent of the enrolments in the first three cycles of academic courses as compared with figures of around 14 per cent at ordinary universities over the period 1969–74. It is more difficult to make firm statements about its costs per graduate at this early stage. In particular, it is too early to consider how far costs per graduate are likely to be affected by drop-out rates. If, however, the university reaches the stage of producing some 750 graduates a year—which seems a reasonable target—then the authors conclude that the cost of producing a graduate with a first degree would be some U.S.$5,600 at 1977 prices compared with a cost at an ordinary full-time university of some U.S.$11,000. If the opportunity cost of students' time is also included, then the comparison is even more favourable to Everyman University.

Thus, the university's early results suggests that distance-teaching methods can be used effectively and economically at this level of education. Success does, of course, depend on the existence of an appropriate technical and educational infrastructure, so that the university can make more efficient use of existing educational facilities. At tertiary level, the cost of regular education is so high that it is possible for a distance-teaching alternative to produce satisfactory financial results at a much lower level of enrolment than is necessary at lower levels of education.

Origin
Kenya
Authors
HAWKRIDGE, D.; KINYANJUI, P.; NKINYANGI, J.; ORIVEL, F.
Title
In-service Teacher Education in Kenya
Bibliographical description
PERRATON, H. (ed.). Distance teaching for formal education: what the projects tell us about cost and effects. Washington, D.C., World Bank, September 1978. (Mimeo. Prepared by International Extension College for the World Bank.)
Subject analysis
Correspondence courses for in-service teacher education supported by video.
Content analysis
The Correspondence Course Unit (CCU) of Kenya was set up as part of the university's Institute of Adult Education in 1967. Its main function was to provide in-service training for primary-school teachers.

As in many countries of the Third World, the demand for education grew rapidly in Kenya after independence and the number of children in primary school doubled in twelve years. It was not possible for the orthodox, pre-service, training colleges to produce trained primary-school teachers to meet the demand for trained teachers. In 1964, the Kenyan Government therefore began to explore the idea of using correspondence and radio to train unqualified and underqualified teachers. USAID provided finance for the project and arranged for a team from the University of Wisconsin to help in setting it up.

The unit has now been working for ten years and offers courses in the major school subjects, each consisting of four elements: (a) textbooks, which are the regular school textbooks in the appropriate subjects; (b) correspondence lessons, written by or for the staff of CCU and providing the additional explanation needed to make the textbooks effective when used by the isolated student at home; (c) radio programmes, produced at the unit and broadcast in order to support the basic teaching in the correspondence lessons and textbooks; (d) work assignments, which the student sends for marking and comment by a tutor. In addition to these four elements there are occasional short residential sessions to back up the distance-teaching methods.

CCU has organized two major teaching programmes: one for unqualified teachers which led to qualified teacher status for those successful in it, and one leading to the Kenya Junior Secondary Examination (KJSE) taken by full-time students after a two-year secondary course. The aim of both courses was similar—to provide a general education, mainly for teachers. They were intended to improve the subject knowledge of teachers, rather than to provide them with pedagogical skills. Thus these were not, in the strict sense, teacher-training programmes.

Between 1969 and 1974, some 8,400 students followed the course for unqualified teachers. For the most part these were older than students on the KJSE programme and had at least four years of teaching experience. A total of 7,600 of these worked through their course, completed two-thirds of the assignments set them and qualified for promotion. In 1974, the programme for unqualified teachers came to an end, in part because there were then far fewer teachers whose limited basic education fitted them for that course. The other programme, for KJSE, continued; but this had always been, and remained, a smaller programme than that for unqualified teachers. Over ten years, some 4,200 teachers and a small number of non-teachers enrolled for the KJSE programme, with an average of 420 enrolments a year.

Comparisons of both costs and effectiveness between the CCU courses and those of the regular system are difficult. The high cost of the United States aid to the programme (some $500,000 between 1967 and 1970 for American specialists) made the costs higher than they would have been without heavy foreign cost components. But even when that factor is taken into account, by considering the costs of American participation at Kenyan, instead of American, rates, the cost per student remained relatively high. The cost per subject-enrolment by correspondence proved to be three times as high as the comparable cost at a self-help, *harambee* school. The reason for these high figures appears to be that the number of students using the CCU system is too small for the necessarily high fixed costs, especially now that the programme for unqualified teachers has been closed down. On the other hand, the programme does seem to have been successful in its main objective of providing in-service education for teachers: teachers have been able to benefit from the opportunity for education leading to higher qualifications and to do so without leaving their schools.

Origin
Republic of Korea.
Authors
Lee, K. W.; Futagami, S.; Braithwaite, B.
Title
The Korean Air Correspondence High School.
Bibliographical description
Perraton, H. (ed.) Distance teaching for formal education: what the projects tell us about cost and effects. Washington, D.C., World Bank, September 1978. (Mimeo. Prepared by International Extension College for the World Bank.)
Subject analysis
Correspondence courses at high school level supported by radio for young people and adults out of school.

Content analysis

The Air Correspondence High School (ACHS) of the Republic of Korea was set up in 1974 by the Korean Educational Development Institute in order to provide high-school-level courses for young people and adults out of school. Primary education, up to the age of 11, is compulsory in the Republic of Korea; beyond that 80 per cent of the age group go on to middle school for three years but only 50 per cent go on to high school. Many of the others start work but wish to continue with their education on a part-time basis and it was to meet their needs that ACHS was set up. It offers courses using correspondence, radio, and fortnightly face-to-face sessions which lead to the same examinations as those taken in regular high schools. By 1977, the school had enrolled nearly 10,000 students for the first of its three grades, 85 per cent of them being between the ages of 15 and 23.

Students follow a programme of courses in up to fourteen subjects. When students have enrolled and paid the appropriate fee, they receive a textbook for each subject taken. The textbook is based upon the regular textbook used in ordinary secondary schools but expanded to include additional explanations and tutorial guidance. It thus takes the place of both a textbook and a correspondence lesson. Within the textbook there are exercises for students to do and send to a postal tutor although, in fact, few of them make use of this service. Once a fortnight, on Sunday, students are required to attend a teaching session at a regular high school. These sessions are staffed by teachers from regular schools, who are paid overtime for their Sunday work. The Sunday sessions are, in practice, compulsory since, unless a student attends two-thirds of them, he cannot go on to the next grade at the end of the year's work. Radio lessons are broadcast daily, six days a week, for all fifty-two weeks of the year. Because of the pressure of air-time (and the failure of attempts to broadcast from tethered balloons) the programmes are broadcast only early in the morning or late at night, without repeats. Students are expected to work four hours each evening; they must also make notes on the radio programmes, and these notes are examined at the residential sessions at least five times each semester. Students are assessed on the basis of their written assignments as they work through the course, their radio notebooks, and two examinations, one set and marked by an ACHS teacher and one set and marked by the Korean Educational Development Institute. The ACHS teaching system thus demands hard work and a high level of motivation from its students. The incentive to work so hard relates to the high differential in earnings between those who have graduated from high school and those who have graduated from middle school. At the same time, the demands of the ACHS system are such that only a very small minority of the age group (less than 1 per cent) enrol for its courses. Until recently, the greater part of the costs of ACHS were met from student fees and not from State funds. But for those who do enrol, the results appear to be remarkably successful: 46 per cent of

the 5,800 students enrolling for the first year in 1974 graduated in 1977, and a number of those who did not graduate then were expected to do so in later years. These part-time students achieved the equivalent of high school graduation, on a part-time basis, as quickly as students in full-time school, although at the cost of an extremely heavy burden of work. Tests comparing the performance of ACHS students with that of students at regular high schools also show that the differences between full-time and part-time students decline as the latter work through their ACHS courses. Students starting at an educational disadvantage were doing something to catch up with their more fortunate brothers, who could afford to go to a regular school.

Comparisons of the costs of ACHS and regular high schools show that the cost per enrolled student, or the cost per student promoted to the next year, are much lower for ACHS students. In 1976/77 the unit recurrent cost for an ACHS student was less than one-third of the cost for a regular high school student. Analysis shows that the expected rate of return for ACHS would similarly be higher than for regular high school students. The teaching methods developed by ACHS do therefore seem to be remarkably effective, as well as cheap, for this particular group of highly motivated students.

Origin
Mauritius.

Author
Dodds, T.

Title
The Mauritius College of the Air.

Bibliographical description
Perraton, H. (ed.) Distance teaching for formal education: what the projects tell us about cost and effects. Washington, D.C., World Bank, September 1978. (Mimeo. Prepared by International Extension College for the World Bank.)

Subject analysis
Educational television and radio to improve quality of secondary education in schools.

Content analysis
The Mauritius College of the Air (MCA) was set up in 1972 by the Government of Mauritius with the International Extension College. Its intention was to use distance teaching methods to improve and extend education within Mauritius with top priority given to the improvement of secondary education. Mauritius already has near universal primary education but only some 7 per cent of the age group go on to government secondary schools. In the early 1970s, another 10 per cent went on to

charitable private schools but over 30 per cent went to private secondary schools which had mushroomed as a result of the unsatisfied demand for secondary education. Thus Mauritian secondary education was dominated by private secondary schools; their teaching was often inadequate, offered by untrained teachers who themselves had had no more than a secondary education, and supplemented by an entrenched system of private tuition. Most children who hoped to pass their secondary examinations also received private tuition, generally offered by their own teachers but in their spare time and at an additional fee. The Mauritian Government was interested in using distance-teaching methods to improve the quality of education in the private schools, and saw this as a higher priority than extending education to the other 50 per cent of the age group outside school altogether.

The Mauritius College of the Air therefore developed a system of distance education designed to be used within classes, under the supervision of the existing, though untrained, teachers. MCA employed teachers, some full time and some part time, to write correspondence courses which would be studied in school, under the guidance of the regular teacher. Broadcasting time on radio and television was readily available and the broadcasting network covered the whole island. Radio and television broadcasts were produced by MCA to supplement the printed texts. These included exercises for students which, instead of being returned to a correspondence tutor, were marked by classroom teachers. MCA's staff ran seminars for teachers working with its courses and arranged a programme of visits to schools in order to guide teachers in the use of its materials. Thus the teaching system was one which gave fairly firm guidance and control to classroom teachers but, with an untrained teaching force, this arrangement seems to have been accepted at classroom level.

The Mauritian educational system has been dominated by a desire for examination passes, regardless of the relevance to Mauritius of the subjects examined: religious (defined as Christian) knowledge and the British Constitution, for example, have been very popular. In an attempt to encourage changes in the curriculum, the College commissioned courses in subjects such as agricultural science, woodwork and human and social biology, which were not previously available in most private secondary schools, as well as in the more usual mathematics and English. Practical kits were developed by MCA and supplied to schools.

For technical reasons it proved impossible to carry out a detailed comparison of examination results between schools using MCA courses and others. Preliminary results in 1973 showed that the MCA methods were resulting in improved pass rates. And there is clear evidence that the courses did enable schools to offer subjects which were not otherwise available to their students.

Since the MCA courses were developed as a supplement to the existing secondary schools, their costs are additional to those already

being incurred. The cost for each MCA course varied, with those which required more face-to-face supervision by MCA staff costing more than those which relied more heavily on print and broadcasts by themselves. Figures for the period from 1973 to 1976 showed that the cost per student began to show reasonable economies of scale at around 5,000 student enrolments a year; at the level at which the college was working in 1976, the MCA costs roughly doubled the cost per subject per student within the private sector. If student enrolments had reached 20,000 (instead of the actual 12,000), the add-on costs of MCA courses would have been 50 per cent of the comparable school fees. The add-on costs of MCA courses do, however, compare very favourably with the costs of private tuition, accepted in practice as an add-on cost by many parents. Thus the early evidence is that distance-teaching methods, although increasing the costs of regular private schooling, could improve the quality of secondary education and do so at a cost comparing favourably with the cost of using private tuition, the alternative supplement to inadequate teaching.

Origin
Nicaragua.
Author
WELLS, S.; KLEES, S.
Title
The Radio Mathematics Project in Nicaragua.
Bibliographical description
SEARLE, B.; FRIEND, J.; SUPPES, P. The Radio Mathematics Project: Nicaragua, 1976, Stanford, Calif., Stanford University, Institute for Mathematical Studies in the Social Sciences, IMSSS, 1978.
Subject analysis
Teaching of mathematics via radio in elementary schools in Nicaragua.
Content analysis
In early 1975, a group of USAID-sponsored researchers and mathematics curriculum specialists began working with Nicaraguan counterparts in Masaya, Nicaragua, on radio programmes to teach elementary school mathematics. The Radio Mathematics Project (RMP) is now completing its first year and is reaching approximately 600 first-grade students on an experimental basis. During 1976, programming was extended through the second grade, and a carefully controlled evaluation of a large-scale implementation of the first-grade curriculum has been undertaken. Present plans call for continued expansion of curriculum coverage to higher grade levels and for implementation of the radio curriculum throughout Nicaragua.

The basic format of the curriculum is a series of 176 one-hour mathematics lessons. Each lesson consists of thirty minutes of radio

(approximately twenty minutes of mathematics teaching and the remainder for announcements and entertainment) and thirty minutes of teacher instruction (approximately seventeen minutes of direct instruction).

Some of the general findings emerging from the first-year evaluation are as follows:

1. Students in experimental classrooms achieved higher scores than those in traditional classrooms on all topics taught by project lessons. The differences ranged from 5 to 24 percentage points. The traditional students attained higher scores for two of the three remaining topics, but neither group performed acceptably.
2. There was an initial underestimate of the general knowledge of Nicaraguan children. Their performance in tests on initial school entry was considerably higher than anticipated. Some of this performance may well be a reflection of the revolutionary role the transistor radio has played in developing countries. Massive radio communication networks are in place virtually throughout the world and we know little about their effects on the knowledge and experience of young children.
3. On the other hand, there was a tendency to overestimate the formal skills of the children on entry into school. The experience of both underestimating general knowledge and overestimating formal skills may be a common tendency in appraising students from rural backgrounds in many parts of the world.
4. Surprisingly, significant differences in performance between rural and urban children were absent from the data. It would be desirable to know to what extent this conclusion holds for more remote rural populations in Nicaragua and, in a more general way, for urban and rural populations in other parts of the world.

Three basic points emerge from the analysis of the costs of the RMP in Nicaragua: In the first place, the intensive efforts put into programme preparation suggest that, unless care is taken to make these programmes available to many users, the cost per student of programme production will be extremely high. The costs can be spread among users by ensuring a long life (10+ years) for the programmes, by implementing the RMP through all or most of Nicaragua, and by attempting to use the same programmes with only slight revision for Spanish-speaking students elsewhere in Latin America or within the United States.

Second, the present planned levels of classroom supervision, teacher training, and student workbook usage results in per student reception costs of \$3.06 per year, or, assuming 150 thirty-minute lessons in a year, costs of \$0.042 per student hour. These costs are exceptionally high, suggesting the value of continued, careful experimentation with lower levels of supervision, less frequent and less intensive teacher training, teacher training by radio, and more limited workbook use.

Finally, it appears possible to reduce substantially the reception site costs and to spread programming costs over a large audience. Even if

this were to be done, the project is apt to remain somewhat expensive by the standards of instructional radio projects. For this reason, principal emphasis in evaluation of the RMP must be placed on its capacity to improve the effectiveness of instruction, as indicated by its effects on mathematics achievement test scores and student repetition rates. It is too early in the project to assess its performance in these terms.

Reports of meetings

Summary report of the Conference on Economic Analysis of Educational Media, Washington, D.C., 2–4 March 1977

Rapporteurs: S. J. Klees, F. Orivel and S. J. Wells

I *Introduction*

This report is intended as a summary of the issues raised and discussed at the conference. We have attempted to outline briefly these issues and indicate some of the different arguments that were advanced. For most of these issues we have derived recommendations for future efforts in the area of economic analysis of instructional technology, based on an examination of what was said and implied in the conference discussions.

We have produced this report from notes taken by each of the rapporteurs. It is not simply a chronology of conference discussions, but rather an attempt to synthesize, in a relatively cohesive, organized fashion, the main points discussed in the three-day period. In the interests of readability, we have not attributed remarks to specific conference participants.

The conference had few presentations and the number of participants was kept small in order to foster maximum interaction and, at least in this respect, the conference seemed successful. The difficulties in

organizing the wide ranging debates and discussions that took place are considerable. We have chosen to group the issues by their centrality to three different, yet quite interrelated, processes: the analytic process, the education process, and the decision process.

The analytic process refers to the more general and technical discussions of the approach to, and limits of, the traditional techniques of economists as regards cost, cost effectiveness, and cost-benefit analysis.[1] The issues we discuss under the heading of the educational process are those most pertinent to the application of economic analysis to the evaluation of educational strategies that involve the use of non-traditional technologies. In the section on the decision process, we examine the interaction of the economists' analysis with decision-makers and decision situations, including questions of the dissemination of economic analysis skills and results. Clearly these are not mutually exclusive processes but it is hoped that the categorization will facilitate our exposition. A number of recommendations that seemed to be generated at the conference are summarized in the final section.

II *The analytic process*

Cost analysis

For a background on cost analysis, the conference had four reference documents at its disposal: the first two are included in the Unesco publication, *The Economics of New Educational Media*, Vol. 1: *Present Status of Research and Trends*, and constitute the synthesis of the first Unesco conference (January 1975), by J. C. Eicher, and the conclusions of the second meeting of experts (June 1975), by F. Orivel. The third was the work of D. Jamison, S. Klees and S. Wells, *Cost Analysis for Educational Planning and Evaluation*. The fourth was a case-study sponsored by Unesco of the costs of an educational television project in Brazil by E. Arena, D. Jamison, T. Oliviera and F. Orivel. The first three documents lay the foundations of a common methodology for the cost analysis of educational technologies, but still leave some unresolved problems, some of which are mentioned in a working document prepared for the conference by F. Orivel. Orivel's paper reproduces a few key passages of the reference documents and stresses the essential technical points of each.

1. The terms 'economist' and 'economic analysis' will generally be used in reference to the particular framework of neo-classical, competitive market theory economics which is most widely used. Although there was a little discussion at the conference and in some of the conference papers and background documents of other economic frameworks, such as Marxist theory, these alternatives were not examined in any depth.

The conference discussions on cost analysis centred around two points that were examined at greater length in the documents above: (a) the various possible classifications of costs, and (b) the nature of the cost analysis to be undertaken.

Cost classification

In some of the background papers for the conference, distinctions were made between accounting, technical, financial and economic classifications of costs. In general, participants considered that accounting classifications, as now practised, were of little utility for the types of cost questions economists ask. Such a judgement reflects, in part, the wide variety in accounting practices within and between nations but, more fundamentally, it reflects the lack of economic notions of social resource use and value in most accounting cost treatments. At the same time, it was recognized that budgetary accounting data are often the chief available source from which to conduct cost analysis. Hence, closer contact between economists and accountants was felt to be useful in the design of cost information systems that could enable such data to meet a wide range of management needs.

A technical classification for costing educational media alternatives that relies on distinguishing central administration, production, transmission and reception system cost components was generally seen as quite useful for facilitating analysis, comparisons and decision-making. There is some discussion in certain of the background papers as to the utility of providing a separate category for initial conception or start-up costs, but this received no attention in the conference proceedings. Orivel's paper recommends that such costs be included within the above categories, if at all possible, and we consider such a policy sensible.

A financial classification that breaks down costs according to the various groups that are incurring them was uniformly agreed upon as a valuable and even necessary aspect of cost analysis. In the past, serious efforts toward this end have been few, perhaps reflecting the tendency of the traditional economist framework to view *total* societal costs as the main criterion for efficiency. However, as more attention is paid to social equity, and as some view the dichotomy between system efficiency and equity as less than clear-cut, concerns with who is paying for the system (as well as who is benefiting) become much more important.

Given that this was, in large part, a conference of economists, it is not surprising that economic conceptions of costs were felt to be the most useful for public-sector decision-making. The primary rationale behind this feeling is that economics has attempted to tie the notion of cost to the measurement of the value that the whole society places on the use of available resources for alternative endeavours. Thus, the economic conception of costs is seen to be a national or global social valuation measure most appropriate to social decision-making. The real relevance of total social costs to decision-making at different levels in different positions

was recognized as problematic although most felt that decision-making incentives need to be structured so as to force decision-makers at least to consider the broadest picture. Such decisions should include the monetary or opportunity costs associated with those resources used that were not paid for from the particular decision-maker's budget. We will discuss some aspects of this general point in Section IV, below.

Within the economic classification of costs, there was some discussion of the specific categories often used by economists to analyse costs, such as fixed, variable, marginal, average, capital and recurrent costs. While there appeared to be some confusing differences in nomenclature between economists (primarily between economists from different countries), the concepts were felt to be similar, and were seen as essential to the analysis. A discussion of alternative categorization schemes can be found in the recent Unesco publication referred to above.

There was some discussion as to whether, and at what rate, to amortize the costs of capital equipment. Although there is a clear consensus as to the necessity of discounting capital expenditures, there appears to be some disagreement as to its practical utility in educational media evaluation. It is certainly true that there is considerable controversy over the particular discount rate which should be used and that the time preferences of society and decision-makers may vary. None the less, it seemed to be the opinion of most economists at the conference, and it is certainly our opinion, that if costs are to be considered in *social* decision-making, then the opportunity costs to the society of tying up capital must be integral to the analysis. Not to consider such costs is to bias the analysis in favour of capital-intensive alternatives and can make a significant difference in the choice between alternatives. This is shown clearly in the report referred to earlier by Jamison, Klees and Wells, wherein the examination of actual instructional technology systems neglecting such costs could underestimate the economic costs of an alternative by as much as 40 per cent.

There was also some discussion of the growing interest in examining costs from the perspective of physical resources utilized as opposed to keeping strictly to a monetary metric. If the world behaved according to the assumptions of conventional economic theory, such an analysis would be unnecessary because international competition would equate all prices with the productivity of the resources to which they are attached. To the extent that such is not the case, and since significant discrepancies exist between wages and prices for equally productive human and physical resources, it is quite useful to collect actual resource use information.

Considerable comment was forthcoming as regards the potential for, and utility of, standardizing the collection of cost information. There appeared to be agreement that the technical and financial classifications mentioned above should be used generally. Within this matrix, however, it seemed difficult, and perhaps dysfunctional, to insist on any standard categorization of economic costs. The distinction between economic con-

cepts, like fixed, variable, marginal and opportunity costs, are decision-specific and thus depend on the specific question asked. There was general agreement that cost information should be collected on as disaggregated a basis as feasible so that aggregation appropriate to a wide range of decision questions would be possible.

Finally, there was some mention of the value of a broader concept of costs that would include psychological or cultural cost facets of a decision. Although not usually quantifiable, especially in a monetary metric, such commonsense concepts were seen as having significant utility for decisions. It is also possible to treat such costs as effects rather than scarce resources whose cost can be calculated, and build them into an analysis of efficiency, effects and benefits as negative consequences of the particular educational strategy proposed.

The nature of the cost analysis

Although the nature of cost analysis is fairly well defined, given the economists' concept of costs and a specific decision question, there were a few general points made at the conference with reference to this topic. First, many participants stressed the point that the type of analysis conducted is directly tied to the decision question and perspective, which relates to the level of decision-making questions raised above and in Section IV. Such considerations lead one to stress the analysis of costs as functions of decision and situational variables, instead of costs as simply monetary numbers, and there appeared to be general agreement that more emphasis on the former approach is necessary.

Secondly, there was some discussion of one particular type of cost analysis—analysis of a summative, historical nature usually undertaken in an effort to facilitate international comparisons and provide for the transfer of information to educational planning situations in which external information is often the only source of certain types of relevant data. Despite general agreement that more of such studies are needed, some participants expressed strong reservations about the transferability of such results. Many felt that the general approach taken in these cost analyses was considerably more relevant than any specific results generated.

Finally, given the uncertainties that surround the collection, measurement, and projection of costs, there was strong agreement as to the necessity of examining the sensitivity of the analysis of reasonable variations in the assumptions made. This clearly relates to the choice of a social discount rate for annualizing capital expenditures, for which such sensitivity analysis is commonly used by economists. But more than this, there is a need to examine other assumptions—human and physical resource costs, equipment lifetime, the growth rate of costs over time, etc.—variation in all of which may significantly affect policy choices.

Cost-effectiveness and cost-benefit analysis

For this topic, which formed the focus for the second day of conference discussions, there were two background reference documents and one paper prepared especially for the conference: S. Wells's book[1] a USAID and report by Klees and Wells[2] served as reference documents, while a shorter paper by Klees and Wells summarizing their longer report above served as a working paper for the session.

In general, there was considerable divergence over the appropriateness, utility and practicality of the economist's framework for this sort of social evaluation. Some participants pointed out that cost analysis by itself had little or no decision value without an examination of system effects and benefits. Cost analysis in theory related resource costs to system outputs more than inputs and thus the question of output is integral to cost analysis. Other participants pointed out the theoretical, methodological and empirical difficulties in looking at the output side and stressed that cost analysis was the primary practical tool economists had to offer decision-makers.

A few participants pointed out that many of the difficulties encountered in measuring benefits in monetary terms also applied to an analysis of costs; most seemed to feel that although such limitations on the use of monetary metric might be significant, it was not an appropriate topic for serious consideration at the conference. However, the authors question whether the tabling of fundamental issues for 'expert' caucusing may postpone a realistic application of economic analysis.

The question of what effects and benefit criteria to focus on in system evaluation received considerable attention. Inherent in this discussion was the realization that although conventional economic theory generates a number of criteria important to examining system success, the objectives of the relevant decision-makers may be quite different. We will discuss this issue in Section IV. There appeared to be strong feeling among a majority of the participants that, in any case, most studies that have been undertaken rely much too strongly on the single criterion of cognitive effectiveness and that future studies should include measures of affective outcomes, longer-term evaluation of both pedagogical and social effects and, in general, should be significantly more 'multicriterial'. A number of issues related to the evaluation of effects and benefits are most directly apparent when viewed in the context of an educational process that can utilize alternative communication technologies, and it is to such a consideration that we now turn.

1. S. Wells, *Instructional Technology in Developing Countries, Decision-making Processes in Education*, New York, Praeger, 1976.
2. S. Klees and S. Wells, *Cost Effectiveness and Cost Benefit Analysis for Educational Planning and Evaluation*, Washington, D.C., USAID, 1977.

III *The education process*

A variety of issues relating instructional technology evaluation directly to the educational process were raised during the conference: the relationship of inputs to outputs, the neutrality of technology, the impact of a technology alternative on economic analysis, the delineation of an 'optimum' configuration of technology for the solution of a particular education decision, the distinction between big and little media, the emphasis placed on hardware and software, and the potential effects of ever-changing communications technology. A crucial issue not discussed in detail at the conference, but raised in the context of marginal cost analysis, is the interrelationship of education and general communication needs through the use of technology. Each of these issues is discussed in turn, and from each we draw conclusions relevant to future research and the role of funding agencies.

Input–output analyses

In undertaking economic analysis, particularly cost-effectiveness and cost-benefit research, we are usually in the position of adding costs and comparing these costs with effects and benefits. In effect, we treat the education system as a black box into which one puts some combination of resources (including technology) and from which one derives some specified outputs. However, there is little understanding of the potential effectiveness impacts from alterations or modifications in the basic combination of inputs. There have been many economic analyses aimed at uncovering relationships between inputs and outputs. However, most of these studies have used process models based more on statistical convenience than on well-established learning theories. It was observed that this investigation of the black box is more a matter for education theorists than economists. Yet, without these studies, little can be said regarding appropriate input combinations which might improve learning. Furthermore, there are very few such studies that look at instructional technology alternatives and those that do have tended to be on gross levels, comparing the utilization of technology with its non-use.

We know little of the circumstances in which a particular technology is appropriate: with which types of teachers, learners, or curriculum we should match a technology. Research strategies need to be developed in this area. Otherwise, we may well be able to identify those instances where a technology project failed or succeeded but will not understand the reasons why and will have difficulty building a base of knowledge with which to advise other countries.

It was also recognized that while there has been analysis of effectiveness (direct educational outcomes), there was insufficient analysis of social outcomes of education or the link between educational outcomes and

social outcomes. Many participants expressed the feeling that while this investigation was particularly appropriate to the economic analysis of education, it was not necessarily relevant to an investigation of instructional technology. This latter opinion rests on the belief that equal outcome alternatives are being compared on a least-cost basis, which may be problematic even for rather technical choices, as pointed out below.

Neutrality of technology

Several people expressed the view that a given instructional technology was simply an alternative delivery system for some curriculum and, therefore, the type of technology utilized would be irrelevant to any estimation of benefits. The analytic impact is that an 'optimal' resource combination can be separately chosen for given educational outcomes. Independent of this analysis, one can then specify the relationship between educational and social outcomes. However, this view contradicts advantages attributed to technology by its proponents, such as technology being an important ingredient to spark an educational reform. Furthermore, during the course of the conference, 'cultural' costs were frequently mentioned, although never specified. One can only infer that 'cultural' costs may well exercise some influence of the technology system separate from the curriculum delivered.

If one looks beyond the instructional technology field, there is considerable literature on less overt media messages. For example, does increased television-watching preclude the need for reading? Do people place a different value on the 'truthfulness' of different media messages? Is a particular technology more appropriate to a particular economic or cultural system?

Obviously, these types of questions have a broader significance for analysis of instructional technology. Yet disagreement was expressed on the neutrality of media. The attempt to resolve this issue is relevant to the need to apply cost-benefit analysis to technology systems. Questions of media neutrality are important issues which deserve more intensive investigation.

Technology and economic analysis

There was considerable discussion of the interrelationship between the educational technologies to be considered and economic analysis. In this subsection, we wish merely to emphasize those areas in which the utilization of technology affects the analysis. In the previous subsection we discussed the potential non-neutrality of technology and advised further research in this area. However, other impacts of instructional technology seemed to be acknowledged by many of the participants. The reduction of student-teacher ratios in multigrade classrooms was viewed as a positive impact. The pacing and scheduling forced by the technology system were

seen positively or negatively, depending upon the individual's perspective.

A major issue for some types of technology is the dramatically different cost patterns to be observed in comparison with traditional systems. Technology systems tend to have major investments in early years of implementation.

The implication of different benefit and cost patterns is that one must adopt a methodology which would result in meaningful comparisons. As different technologies may have positive or negative effects on different measures, one must adopt methodologies which account for altering sets of criteria.

'Optimum' configuration

Several persons held the opinion that the primary role of economic analysis was, on a micro level, to find an 'optimum' resource configuration that would result in minimizing costs for a fixed output level. This opinion implies that the relationship between inputs and outputs is actually understood, and that one could alter input configurations without changing output. The research implication drawn from this is, again, further investigation of input–output relationships and, perhaps more importantly, more research directed towards solution of specific decision questions. Not all economic analysis should necessarily be in a global context involving choice among major systems; some should also involve decisions within the constraints of a previously chosen system.

Big media—little media

Some discussion was focused on the difference between big and little media. While there was considerable agreement that little media tended to be ignored, several definitions were offered distinguishing little media from big media and providing rationales for the tendency to neglect the former. When this dichotomy was first proposed several years ago, the implication was that big media were more expensive. While this difference may be true for hardware investment (and this is not certain), the tendency is to ignore two major cost items for little media: distribution and electrical power. With poor transportation and the unavailability of less-expensive main-line power, these two items are likely to contribute greatly to operating costs. Over a long period of time, either media system may be the more expensive.

An alternative definition offered was that big media tended to require large initial investments in equipment while little media had lower investments. Tied to this point were the underlying decisions in international funding of media projects. Funding tends to be available for major investments rather than operating costs. Preparation, duplication and distribution of material for little media tend to be viewed as operating costs.

Another definition offered was that big media tended to be highly centralized, whereas little media were decentralized. The rationale for centralization would be a greater desire for curriculum control and an unwillingness to rely on teacher ability and initiative in all areas of the country. However, little media may still involve centralized curriculum production. The teacher would then have a scheduling option. Big media use does assure that if equipment is functioning and teachers follow directives, lessons may be centrally paced.

Related to this definition was one which distinguished between those media for which teacher involvement was necessary and those for which it was not. However, it would seem that one could establish a direct student-medium interface for any medium and have a student-teacher interface as a lead-in or follow-up to any medium use. An additional reason for the relative neglect of little media was a lack of glamour attached to these media and the fact that their use tended to be a local option.

On one point, however, there was virtual unanimous agreement: big media (radio and television) are the most studied and little media (everything else) are the least studied. The important recommendation derived from this discussion was the need to place much stronger emphasis on little media systems, especially in planning studies.

Hardware and software

When we think of media systems, we tend to think of hardware: facilities and equipment. An instructional television system consists of production facilities, television sets in the classroom, and some method of transmitting messages (satellites, microwave, cable, etc.). While the hardware components of a media system may be relatively easy to specify and estimate cost for, the hardware is not an instructional system. The true differences between media successes and failures may be more a result of software differences—curriculum development and overall system organization. While economists are not appropriate professionals to make curriculum or organization recommendations on their own, the implication of this discussion at the conference was that without serious consideration of software elements, rational choice through economic analysis would be difficult.

Everchanging technology

The communications field is one of rapidly changing technology. There are continuing innovations as regards the amount and speed of information exchange through technology. For example, relatively inexpensive portable video units now provide the possibility of local course production. The implication for education is that researchers and funding agencies must not become so fixed in given education structures that

they fail to see the education possibilities of new innovations. It was recommended that technical expertise be included in any planning effort.

The change of technology does pose two problems for developing countries: (a) a potential inability to deal with pressures of hardware salesmen, and (b) an increased likelihood that outmoded equipment may be thrust upon developing countries.

Education and general communication needs

A point that was only briefly mentioned in the context of marginal cost analysis was the link between education and other communication needs in a country. It was suggested that if a radio or television system already existed in a country, then one need only consider the marginal cost of using this system for education. The more general point which emerges from this is a need to co-ordinate education planning utilizing communication technology with general communication needs. Otherwise, if the education system is made the focus, facilities may be duplicated or equipment may be unnecessarily purchased and potential saving through sharing of facilities may be ignored.

IV *The decision process*

Throughout the conference there was discussion of the relationship of the economist and economic analysis to the education decision-making process. In this section, we discuss three aspects of this relationship that seemed to be focal points: (a) the source of the objectives and questions for analysis; (b) the interaction between the type of decision situation and the type of economic analysis engaged in; (c) the dissemination of skills useful to economic analysis and results from economic analysis. Naturally, all three issues interact considerably.

Objectives and questions

A number of participants stressed the need to begin an analysis with decision questions, as opposed to general inquiries such as 'How much does this cost?' For example, the information collected may be quite different for a historical cost summary of a project than when the real interest is concentrated on project expansion or applicability of the project to a different environment.

Even if a decision question is involved, by what criteria should alternative answers to such questions be judged, and from what source should both these questions and criteria be obtained? Such concerns led to some questioning of the role of the 'decision-maker'. Some participants

noted that economic analysis, with its traditional 'optimization' framework, is well suited to work with a central decision-maker. However, others cautioned that in many situations there are often no identifiable individuals who are decision-makers, but some sort of amorphous political process by which decisions get made and within which it is hard to identify the locus for discussions of the relevant questions and objectives.

Clearly of great significance is the question of whose objectives are to guide system choice. The view that economists should accept decision questions and objectives laid down by people who are in positions of public decision-making responsibility received support by some participants. This view was tempered, however, by the recognition that economics traditionally has a number of evaluative criteria that emanate from within it, related to conceptions of social cost, social benefit, and economic efficiency. Therefore, many participants argued that the economist should actively foster the incorporation of such criteria into the decision-making process. A number of people remarked on the lack of specificity of objectives that characterize many initial decision situations, and it was certainly appropriate and perhaps necessary for economists to help clarify decision questions and objectives. There seemed to be fairly uniform agreement that one potentially valuable role for economic analysis is to help make decision assumptions and criteria explicit.

Finally, there was recognition that a public-sector decision process is a political process in that there are various groups involved, often with conflicting interests. Some participants argued the necessity of competing interest groups undertaking their own economic analyses. Although this runs counter to the traditional economic approach, two rationales provided some justification for undertaking competing analyses. First, some argued that the traditional 'objective, value-free' stance of mainstream economics is incorrect and that economic efficiency has serious flaws, both in conception and application, which render its use as a criterion more a political judgement than a scientific one. Second, others argued that even if one felt confidence in competitive market economic theory, our ability to apply it is so inexact that analysts could, in good faith, disagree within the paradigm. Within a very centralized decision process, these considerations provide a rationale for the same decision authority funding evaluations from different perspectives. Of course, given that the central authority may be one of the interest groups itself lends doubt to its ability to fund a study with a different bias.

Decision situations

There was considerable reference in the discussion to particular aspects of the decision situation and how they might affect the role of economist and the nature of the analysis. Different levels of decision-making perspective and responsibility were suggested as having different analytic implications. Distinctions were made between international agencies like Unesco

and the International Council for Educational Media (ICEM), international advisory and financing organisms like USAID and the World Bank, national decision-makers, and project management. These different levels of decision-making were sometimes associated with (and sometimes confused with) different types of decision questions, such as those related to financing, social costs, or media mix.

While the type of decision question being asked has clear implications for the type of analysis that is most useful, the effects of the level of decision-making on the analysis did not seem to be well clarified by the discussions. Certainly there was a dimension that relates to the point made in the previous subsection—that different decision perspectives may view different factors as costs and benefits. But more than this, there was considerable discussion of the particular aspects of economic analysis most useful to particular decision situations. Arthur Melmed, chairman of the conference, summarized his view of the proceedings within this framework.

In general, a number of participants felt that cost analysis was the best defined component of economic analysis and would be of most use to real-world decisions. However, others argued that cost analysis could not be meaningfully considered by itself without an integrated examination of system effects and benefits. Some added that the most questionable assumptions of economic analysis on the benefit side were the same as those made on the cost side and thus both types of analysis potentially have the same flaws. The discussion reflected an underlying difference of opinion, sometimes explicitly expressed, over the decision importance of the technical, quantitative, empirically based aspects of economic analysis relative to the usefulness of the more qualitative, general conceptual approach of the economist. Which aspect is stressed has clear significance for the nature of the analysis undertaken and the transfer of economic analysis skills to others.

There was fairly broad agreement that in many decision situations much more effort than is currently the practice should be put into ongoing continuous analysis of projects, from the planning stage through implementation, with permanent economic evaluation built into the eventual operational phase of the project. There was also fairly uniform agreement that, given the complexities of most decision situations, economists should be integrated with analysts from other disciplinary perspectives into a multidisciplinary evaluation effort.

In general, despite the view that economic analysis as an aid to decision-making is more or less uniformly applicable, it would seem that more attention should be given to the particular approaches to analysis and their relationship to particular decision situations. Such attention could perhaps be most usefully generated through closer interaction between economists, researchers from other disciplinary perspectives, and those people responsible for making decisions, both in actual project situations and in meetings designed specifically for that purpose.

Dissemination

Relatively few economists are currently engaged in efforts to look at the economics of educational media strategies, and few decision-makers or researchers from other disciplines have the requisite background to interpret sensibly the economic work that is being done. Both of these considerations led to general agreement that more attention should be focused on the dissemination of economic analysis results and skills.

More widespread dissemination of studies was called for. There was some debate over whether the results were very generalizable, but even if the results were not, participants felt that the approach taken was likely to be, and thus, in either case, this recommendation was considered valid.

Some participants argued that some sort of data banks that collected quantifiable information from specific evaluations could be useful, while others felt the limitations on generalizability would preclude this specific approach from being very effective.

There was a general consensus that the dissemination of economic analysis to non-economists, especially to decision-makers, is of essential importance in fostering the interaction between economists and other parties involved in the decision process. It was felt that such dissemination of both conceptual framework and technical skills required a multifaceted approach involving clearly written papers on the subject, supplemented by personal interaction, seminars, and extended education and training efforts. There was significant concern that the recipient be integrally involved in questions of the substance and form of such dissemination activities. In exchange, economists would be exposed to the process of decisions and the practical implications of their assumptions and methodologies.

V *Conclusions*

In a sense, this whole report represents the conclusion, as viewed by the rapporteurs, of the conference deliberations. The wide range of topics were discussed or touched upon. All have implications for the many different groups involved in the evaluation of educational media alternatives—economists, and other researchers concerned with education; educational decision-makers, administrators, and users; and international organizations involved in financial and technical educational development assistance. In this section we briefly summarize what we see as the major suggestions and orientations for future work that came out of the conference. Most of these points apply in some respects to all three audiences above, but are grouped here in four general categories:

Methodological approaches to research and evaluation activities

Cost analysis

1. Divide media system costs into the technical classification proposed: production, transmission or distribution, reception, and central administration components.
2. Divide media system costs according to a financial classification, depending on which groups pay.
3. Do not attempt to standardize within the economic cost classification, as classification by such concepts as fixed, variable, and marginal costs should reflect specific decision questions.
4. Collect and present information on physical resource use, in addition to monetary costs.
5. Collect and present (or at least make available) monetary and physical cost information on as disaggregated a basis as possible to allow for aggregations specific to other decisions than those under consideration at the moment.
6. Structure cost analyses so that they reflect responses to specific decision questions.
7. Structure cost analyses so that they reflect costs as functions of relevant decision and situational variables, as opposed to simply considering costs as numbers.
8. Devote research efforts towards integrating different dimensions of individual and social costs into cost analysis, such as psychological and cultural aspects of costs.
9. Include opportunity cost estimates of non-priced resources used in media projects, not omitting the use of alternative social interest rates to discount capital expenditures.

Cost-effectiveness and cost-benefit analysis

1. Include multiple effectiveness and benefit criteria in future studies, as opposed to the prevalent one-dimensional emphasis on cognitive effectiveness.
2. Attempt to structure the analysis and employ techniques to yield more detailed understanding of the relationship between educational inputs and outputs, as opposed to examining the 'black box' effects of a system as a whole.

General educational and analytic considerations

1. Devote more research effort to technology systems which do not use radio and television, especially so-called 'little' media systems.
2. Devote more attention to software components of technology systems.
3. Consider wider societal communication needs in analysing technology systems for education.

4. Investigate the non-educational impacts of particular technologies more thoroughly to determine the extent to which it is reasonable to choose an educational delivery system based on educational impacts alone.
5. Devote considerably more effort towards further conceptual and methodological work relevant to the theoretical validity and practical applicability of these types of economic analyses.
6. Undertake sensitivity analysis within all economic analysis based on reasonable alternatives to the main assumptions used.

Relating research and evaluation to the educational decision-making process

1. Tie management information systems, most specifically those for accounting data, to the requisites for economic analysis.
2. Promote the incorporation of criteria relevant to total societal costs and benefits that emanate from the economist's framework into the framework used by decision-makers at all levels.
3. Undertake analysis from a variety of different, even perhaps competing, decision perspectives, recognizing explicitly that decisions often take place in a political process of divergent views and that analysis is not neutral.
4. Focus more research and more practical studies on the different needs of different levels of decision-makers and the potential for economic analysis to be more level-specific.
5. Foster the inclusion of economic analysis through the final implementation phases.
6. Promote multidisciplinary efforts in conjunction with specific decision-making activities, bringing together economists, researchers from other disciplines, and decision-makers, recognizing that all have much to learn from each other.

Dissemination and transfer of economic research and evaluation skills and results

1. Promote the inclusion of economic analysis approaches and techniques in formal training programmes that exist for decision-makers at all levels—general policy planners, education sector analysts and decision-makers, and project managers.
2. Promote the circulation of reports, conceptual and technical training documents, and lists of information sources and experts who are able to serve as consultants to decision-makers at all levels.
3. Promote the use of international teams of analysts who could bring expertise and the relevant experience of former projects to working with, and providing training for, personnel involved in new projects.

4. Promote dissemination activities relating to conceptual aspects of and generalized approaches to economic analysis, as well as the transfer of more technical skills.
5. Integrally involve the recipient in determining both the form and substance of dissemination activities.

Specific foci for international aid organizations

1. Support studies dealing with the evaluation of more than one medium of instruction.
2. Support studies that integrate cost considerations with effectiveness or benefit considerations, as opposed to those that treat each separately.
3. In line with the foregoing point, encourage economic analysis that takes place within a multidisciplinary context and that examines a wide range of system outcomes.
4. Do not attempt to impose too detailed or standardized a framework within which to structure such economic analysis.
5. Encourage and support more theoretical and methodological research in line with the suggestions made earlier, as well as more practical case-studies of projects at various stages of development, with an eye on lessons to be learned for both analysts and decision-makers.
6. Devote significantly more effort towards promoting dissemination activities as suggested above, through providing considerably more opportunities for interaction between economists and other decision-makers in the form of global and regional meetings, position papers and manuals, and other activities that will facilitate mutual learning.

Final report of the Conference on Economic Analysis, Factor in Decision-making on Educational Technology, Dijon 19–23 June 1978

Rapporteurs: E. Arena, E. G. McAnany and F. Orivel

Preparation and organization of the conference

The conference was organized jointly by the French National Commission for Unesco and the University of Dijon and was held in the university's buildings. The Institut de Recherche sur l'Économie de l'Éducation (IREDU), which comes under the University of Dijon, and the

Centre National de la Recherche scientifique (CNRS), handled practical arrangements and provided the secretariat. The Director of IREDU, Professor J.-C. Eicher, acted as the scientific director of the conference and Mr F. Orivel, senior researcher at CNRS, served as secretary-general.

The International Council for Educational Media (ICEM) helped a great deal with arrangements, particularly by organizing the travel of participants from developing countries and by preparing working papers. The International Development Association (IDA) of the United States and the EDUTEL Company also afforded valuable assistance by making it possible for most of the Americans and Canadians to attend the meeting and by submitting case-studies.

Through the efforts of Mr Futagami and Mr Jamison, the World Bank played a decisive role in drawing up the preparatory documents of the conference. The financial, practical and human contribution of Unesco should also be gratefully acknowledged.

Economic analysis of educational technologies: the state of the art

The first day of the conference was devoted to a review of past experience in three important areas: economic analysis of educational technology, the experience of developing countries in handling educational technology and the present situation of the educational media in industrialized countries. These were dealt with by J.-C. Eicher, E. G. McAnany and R. Lefranc respectively, all of whom devoted the bulk of their contributions to defining the main problems at present found in the three fields.

1. In the opening paper, 'Some Thoughts on the Economic Analysis of New Educational Media', Jean-Claude Eicher reviewed recent findings before raising a series of questions on points which, in his view, required more thorough investigation. His paper is to be found at the beginning of this volume (page 9).
2. In a paper reprinted on page 48 of this book, E. G. McAnany asked what criteria should be used to judge whether media projects in the Third World have or have not been successful.
3. Lastly, Robert Lefranc presented a paper on the use of the mass media in industrialized countries. He began with the historical background of the new educational media and then outlined present trends, emphasizing the technical problems they raised.

Lefranc showed how, from 1950 to 1970, the media developed at a time when pupil and student numbers were expanding rapidly and there was a shortage of qualified teachers. The response to this challenge developed in stages which can be described as follows.

The first step was to employ audio-visual techniques to back up the traditional approach to teaching. This gradually led to teaching methods in which these media were more satisfactorily integrated.

Next, the late 1950s and the 1960s witnessed the use of mass media such as radio and television to meet the particularly pressing need for teachers in certain subjects such as mathematics, science and languages.

A third stage, overlapping the second one, saw the development of completely new teaching systems based on the media themselves. Although still experimental, this approach is attempting to rethink education as an interactive process involving students, teachers and the media, and has brought into being systems of distance learning in which the 'school' disappears and hitherto excluded social groups are given the opportunity to study, particularly at the secondary and higher levels.

Summing up, Lefranc said that in the last twenty-five years, those approaches had not replaced one another but had been added to each other and still existed side by side.

Lefranc considered the chief educational objective in the present decade had come to be the democratization of educational opportunity. In his view, the media and their growing ability to spread information are making it possible to develop individualized instruction and thus promote mass education. The media are also making it easier to give everyone the opportunity to learn. The cost of equipment is tending to fall and there is a growing variety of software. Teaching methods are following this lead as the media become more co-ordinated (systems analysis and the promotion of pupil creativity) but these developments are making it necessary to retrain teachers in the new techniques.

In his final section, Lefranc turned to certain problems raised by the development of the media. First, the question of strategy: should education systems be reformed little by little or as a whole? The second problem concerns the teaching profession's trend towards teaching teams made up of librarians, media specialists, documentalists, etc., and fewer teachers of the traditional type. Problems of production and distribution are necessitating more co-operation between education systems and media industries. Architecture must be rethought to accommodate the media, school administration must provide new staff categories and patterns of organization, and educational budgets must be redesigned. Finally, the author reiterated his belief that the best way of providing an education more closely adjusted to the individual personalities of students was by using the mass media.

The issues raised during the debate which followed these introductory papers have been grouped under four broad headings: (a) the comparability of studies; (b) effectiveness criteria; (c) technological transfer; (d) the specific problems of non-formal education.

Comparability of studies

There was a great deal of discussion about the extent to which studies of projects with very distinctive settings and features could be of use in making decisions in quite different situations. Some held that apart from

certain analytical techniques, case-studies contained little that was genuinely helpful in responding to new situations. Others argued, however, that studies of this kind serve a useful purpose when they draw attention to environmental factors which vary from one project to another and thus allow what is constant to emerge. That was a basic principle whenever it was wished to generalize social science findings. Since similar applications of distance-learning systems are being tried out in very different contexts, the results of cost-effectiveness studies can help to define models of use to the planner or policy-maker. Jamison and McAnany, in a recent book (1978), have attempted to highlight this kind of model. In his address, McAnany suggested developing planning techniques which would not just monitor the projects' internal factors but would also seek out the external or environmental factors that were favourable to the success of that kind of project.

Criteria of effectiveness

Participants broadly agreed that project effectiveness had been analysed less thoroughly than costs and that the selection of criteria of effectiveness was a greater source of disagreement than the selection of cost parameters. Eicher in particular pointed out that there is still little agreement on what effectiveness actually means in most educational technology projects. McAnany spent much of his paper on showing how effectiveness criteria change from one project to another and are often founded on value judgements belonging either to the project itself, to the evaluation or to those who ask for the evaluation. Most participants agreed that cognitive measurements alone were not enough to gauge effectiveness, but there was no detailed discussion of exactly what other indicators should be taken into consideration. Some progress on this point, however, was made in the working groups (see the section below on problems and solutions).

Technology transfer

Many participants, including some sympathetic to employing the mass media in education, cast doubt on the realism of the estimated cost and the possibility of transfering new technologies. Some of Lefranc's suggestions, for example, were queried as being idealistic and too costly for most education systems, especially in developing countries. As Eicher pointed out, cost forecasts for projects involving new technology are very often underestimated. Some costs are left out, either because certain facilities are used without payment or because related activities engendered by the introduction of the new system are not taken into account. No significant discussion took place on certain advanced technologies such as the use of satellites, the central concern being to concentrate on more modest and hence less costly media.

Non-formal education and choice of technology

A relatively new interest has been taken in non-formal education, which covers many areas from adult literacy programmes to campaigns aimed at improving health standards, hygiene, nutrition or agricultural productivity and development. So far there have been few attempts at economic evaluation in this field, but several conference papers dealt with the issue. Howard Tuchman summarized his cost study of the radio school in Colombia (ACPO), an important study in that it could provide a methodological framework for the thirty-three educational radio projects operating in Latin America. Joanne Leslie used a dozen cases, unfortunately without data on cost, to show how the media had been used—and with what success—to improve hygiene and nutrition. Bella Mody analysed the external factors of change in an Indian village involved in the SITE project (Satellite Instructional Television Education) during the year 1975/76. H. Razavi presented some thoughts on the concept of educational technology and Raymond Postgate defended 'soft' technologies which use small-scale, locally controlled media designed to meet the needs of clearly defined social groups in both developed and developing countries.

It emerged clearly that non-formal education was faced with problems similar to those of formal education and others besides, but did not have the same experience of evaluation. New technologies are increasingly important in this field but there is still little information about costs and effectiveness. Many participants stressed the urgent need for economists and evaluators to take a close interest in non-formal education. Jamison and McAnany have, in fact, devoted part of their recent (1978) book to gathering available information on the role of radio in this field.

Problems and solutions

For two days the conference separated into six working groups to examine the following problems: (a) distance-learning systems at the post-secondary level; (b) other distance-learning systems, in particular for non-formal education; (c) use of the media in schooling; (d) improvement of existing systems by means of the mass media; (e) criteria for deciding on the choice of media; (f) analysis of Latin-American media projects.

The groups made what use they needed of the working documents at their disposal and appointed rapporteurs to record their conclusions, which were later distributed to all participants and examined at a plenary session. The main points that emerged from this examination can be grouped as follows: (a) the scope of economic analysis; (b) definition and measurement of effectiveness; (c) decision problems in regard to educational media; (d) the usefulness of economic analysis; (e) the role of economists.

The scope of economic analysis

Economic analysis is a technique that can contribute to the decision process regarding a given educational technology. The questions that economists ask, and seek to answer, may not be very different from those asked by educators or planners, but concentration on cost and cost effectiveness might distract attention from more fundamental issues such as the relation between education and society. Certain participants remarked that economic analysis is not always neutral: the economist's criteria might be distorted by concerns of the organization paying for his analysis or by his own ideological stance.

Moreover, many of the studies referred to in the discussion tended, largely for technical reasons, to be cost studies rather than true cost-effectiveness analysis. Even when 'benefit' or effectiveness indicators were present, they were rarely set in a true cost-benefit framework.

The definition and measurement of effectiveness

Even though some of the documents provided for participants offered formal definitions of effectiveness and how it should be measured, no consensus was reached on this point. The fact that the concept has so many facets naturally tends to complicate the task. It was suggested by some speakers that every case-study should examine the internal, external and systematic aspects of effectiveness. Internal effectiveness might be judged on the pass, repetition and drop-out rates and on the extent to which resources are utilized; suggested indicators for external efficiency were the achievement of specific objectives, the number of graduates, improvements in professional qualifications, employment of graduates, productivity, changes in behaviour, influence of education on the community, satisfaction of needs, socialization, and the quality of education; the indicators selected to measure systematic effects were reduction of social and economic inequalities, the changes induced in traditional education systems, spill-over effects on non-target segments of the population, and the training and in-service refresher training of teachers. It will obviously be very difficult to take such a wide range of effects into consideration.

In the first place, where *a posteriori* evaluation is concerned, it is never very clear what the initial targets were since they are rarely quantified beforehand. Even when the initial project contains precise information, certain objectives may change during its implementation. Lastly, it must not be forgotten that the inherent limitations of the social sciences and our far from adequate grasp of educational projects based on the media make many results impossible to foresee.

The second problem is the measurement of certain indicators: the concepts underlying them do not all have a univocal significance which would make it possible to reduce them to a figure. Even when this is possible, there arises the difficulty that data are not usually collected systematically throughout the project. Nevertheless, in spite of such limi-

tations and constraints, it was recommended that the most awkward aspects of the projects should be evaluated at least qualitatively rather than simply disregarded.

Thirdly, it has to be recognized that a very long time elapses between the start of an educational project and the moment when its final effects may be observed. The result is that cost-effectiveness analysis often takes place before long-term effects can be gauged. A different though related problem is that the results of a pilot project cannot be extrapolated to one on a normal scale since there are always differences in motivation among project leaders, teachers and learners.

The fourth problem concerns what economists call the production function of education. There is at present no proper theory to explain how inputs relate to outputs in the field of education. With no unchallenged model of causal relationships in regard to education, it becomes very difficult to isolate the impact of a particular medium on a given educational process.

The problems of deciding about educational media

The case-studies prepared for the conference shed little light on how economic analysis had affected the decision process. True, economic analysis is still a novelty in this field and the projects studied existed before it was introduced. The case-studies are mostly *a posteriori* cost studies, with a few on effectiveness, but none deal with comparative cost-benefit analysis prior to decision-making.

In spite of these shortcomings, there seemed to be general agreement that economic analysis should play its part in decision-making and be part of the multidisciplinary effort to weigh up the implications of various possibilities and thus clarify the decision process. The systematic organization of information involved in economic analysis provides a convenient working framework and the economist's viewpoint can sometimes serve as a valuable check to the adoption of solutions which are fashionable but disastrous in the long run.

Thorough analysis of actual decisions taken concerning educational media might reveal that information available for decision-making is often incomplete and that a bias exists in favour of certain factors. When a project is being prepared, for example, it can happen that favourable external factors, such as political support, play a much more decisive role than considerations of economic efficiency. Several participants stressed the importance of distinguishing between the analysis of ongoing projects on the one hand and feasibility studies and policy decisions on the other. The technical decisions needed during implementation should be based essentially on solid, straightforward economic considerations. Some examples of this type of decision were given: (a) the cost implications of either using existing facilities more intensively—thus incurring higher labour costs—or expanding the facilities; (b) the cost implications of various possible media combinations for a distance learning system; (c) the

economic implications of decisions regarding the amount of educational content; (d) the implications of decisions on whether the target audience should be broadened or not.

All these decisions share the need for a choice between the status quo and expansion, and call for marginal analysis and hence economic expertise.

On the other hand, feasibility studies require closely integrated teams of educationists, planners and economists to define the problem, the objectives of the project and the intended audience, to select the media to be used, weigh up the available resources, advise on financial arrangements and lay down the relevant variables to be used in evaluation.

Where policy decisions at the highest level are concerned, there are still too many obstacles to make direct comparisons valid, even though a certain amount of progress in project comparison has been made. The objectives, audiences, types of organization, environments, media combinations and available information differ far too much for it to be possible to classify systems in terms of cost-effectiveness and identify the 'best' technology. Nevertheless, at an intermediate level, economic analysis can certainly make it easier to anwser certain strategic questions such as the one now being asked by the Latin-American Association for Radio Education (ALER)—can educational radio effectively attain certain predefined educational objectives at lower cost than regular schooling?

A final point regarding the contribution of economic analysis to decision-making was that economics is not an exact science. Two economists examining one and the same project might well reach opposite conclusions.

The usefulness of economic analysis

The economic analysis of educational technology has proved its usefulness in three areas: (a) economic studies have built up a body of knowledge on educational technology that did not exist before, and this information can now be used in shaping strategies for the development of new projects; (b) economic analysis provides more reliable foundations for project financing by education ministries or international organizations; (c) it has conferred international credibility on certain projects which otherwise might well have collapsed.

There is, however, a great deal of scepticism as to whether economic analysis could modify positions already taken up. It has, moreover, come up with few straightforward proposals that could guide—if not optimize—decisions which have to be taken without waiting for the findings of a detailed study.

The role of economists

The foregoing remarks indicate the ways in which economists could contribute to the taking of decisions about educational media. They could

analyse resource allocation in the education process and help towards a better understanding of it: they could join teams set up to produce feasibility studies or advise on the most desirable education policy; they could be consulted on the economic or other consequences of alternative courses of action and thus improve the decision process; they could teach or spread certain analytical techniques and, lastly, provide a cogent analytical framework for decisions about the media.

Conclusions and recommendations

The main purpose of the Dijon conference was to inform specialists in the use of mass media for education about the recent efforts—covering not more than the last ten years—of a few economists. The conference was successful in that 111 specialists accepted the invitation to come and meet 22 economists. Contacts were made and a great deal of documentation on the economic analysis of the media, which will probably be read through carefully in the coming months, was distributed to participants. The conference led to a greater awareness of the need to set up pluridisciplinary teams and gave participants a chance to discuss plans for future collaboration.

The scepticism expressed in some quarters over the relevance of an economic analysis of the use of the media in education was more than justified when it served to counter a tendency to make economic analysis the central if not exclusive approach to the problem. If the economists were tempted to take this line, they will not do so again. Non-economists, on the other hand, were made aware that resource wastage cannot take the place of a criterion for decisions about educational technology. The Dijon conference confirmed the end of an era in which recourse to the media in education was a fashion and gratuitous experiments could be conducted for pleasure. The new educational technologies of the coming decades will be those which provide higher quality and/or a greater quantity of services to education from the same resources or which make it possible to maintain the same services at lower cost.

The conference also gave close consideration to the creation of an international network for updating information on economic and technical problems raised by the development of educational technology, and to future activities for the economic analysis of teaching media.

Information network

The document prepared by Dr K. Spangenberg[1] notes that there are several networks of bibliographical information on education in the world but none of them satisfactorily covers the studies, reports and books which

1. 'Possibilities for the Inclusion of Information on Costs of Educational Media Systems and on Characteristics of Audio-visual Materials and Equipment into the Information Network of Unesco-IBE'.

deal with the economic analysis of educational technologies based on the media. Even though these documents have rapidly grown in number in recent years, there are no specialists handling this field in present information networks. Setting up a network of this kind, which Spangenberg refers to as COCEMS (cost and characteristics of educational media systems) presupposes answers to these three questions: (a) Who is it for? (b) What type of information should it convey? (c) How should it be structured?

Clearly, an unambiguous definition of its users would make it possible gradually to determine the kind of information wanted by means of feedback from users. Conversely, if a start is made by defining the kind of information to be circulated, the users would be identified by approaching the membership of existing networks within which most potential COCEMS users would form a sub-group. In other words, the first step is to define either the intended audience or the information and then leave the other variable to sort itself out. This choice gave rise to differences of opinion and it proved impossible to reach an understanding. Some had a clear idea of the information to be circulated and felt it unnecessary to worry about users, whereas others had well-defined users in mind (e.g. education policy-makers in developing countries) which, of course, made it possible to specify the type of information to be circulated but excluded the needs of other potential users.

Agreement was reached on points of secondary importance: (a) an information bulletin in Arabic, English, French, and Spanish should be envisaged; (b) the abstracts of studies should be critical abstracts; (c) studies dealing only with the characteristics features of systems, with no indication of cost, should be excluded.

It was generally recognized that Unesco possessed an international system of dissemination, especially through the IBE information network. This made it pointless to set up an entirely new network. One or more centres specializing in the processing of this type of information should be connected with the existing network. Several centres, selected on a linguistic or geographical basis, seemed preferable to one alone.

It was hoped that Unesco and IBE would undertake a feasibility study on a network of this type.

Future activities in the economic analysis of teaching media
Participants made a good many suggestions on this subject. These are summarized below.

Guidelines for a research programme. Effectiveness is now the central problem. However, the impact of education in general has to be distinguished from that of specific educational technologies. For example, can a particular case of rural exodus be regarded as a consequence of schooling, of television-assisted education, or of other factors such as the strong pull of the urban life-style conveyed by means other than education? In practice,

the concept of effectiveness should be approached from several angles:

A survey to find out who really wants information on the effectiveness of a project, and why.

Research on classifying levels of effectiveness (internal, external, systemic, etc.) in order to identify the effectiveness subgroups and establish a table to correlate findings; this table would then be set alongside the one drawn up for cost analysis.

A cross-disciplinary study of effectiveness which would review the relevant work and findings in the social sciences, economics and the education sciences.

A critical analysis of effectiveness studies already carried out on the impact of new teaching media, with the purpose of clarifying the methods employed to measure it.

Studies. Encouragement should be given to the formation of multidisciplinary teams for the preparation, study and evaluation of educational projects employing the new teaching media and a special effort should be made to carry out effectiveness and cost studies at the same time and in close conjunction with each other. One important aim of such studies, especially those dealing with ongoing projects, is to point out ways and means of improving the output of the structures, resources and facilities in use (optimization and maximization). Particular attention should be paid to making the reports more readable, so that non-specialists are not lost in a trackless jungle of theory. Lastly, it was stressed that the economic analysis of media systems should bear in mind the economic policy of the country in question.

Circulation of economic research findings. Besides being used in large-scale projects, the new teaching media are also employed in a great variety of small projects (resource centres, language laboratoires, closed-circuit television, multimedia schemes, etc.) none of which costs enough on its own to warrant the expense of economic analysis. There are, however, so many of them that the total expenditure may exceed the cost of a big project. This is why it is important for those in charge of minor projects—very often teachers, school heads or inspectors—to have at hand methodological aids to help them justify their decisions. One of the foremost recommendations of the conference was that a guide on how to cost media micro-systems should be produced. This would contain advice, parameters and models to help decision-makers themselves (educationists or practising teachers) to analyse the systems' economic aspects, predict their cost and draw up budgets. The guide could also draw attention to the pitfalls and limitations involved in planning to introduce media-based projects.

Training activities. Another suggestion concerned the organization of workshops or training courses on the application of economic analysis to

educational technology from the decision-making point of view. Workshops of this kind, organized on a regional basis, should be for a limited number of active or future decision-makers and should include simulation techniques in which the group would have to work on an imaginary example, carefully prepared beforehand.

Institutions and experts

Directory of specialized institutions and experts

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Centre de Recherche en Économie Appliquée, 20 Rue Chalid Mustapha Khalif, Ben Alenoun, Algiers.	Idir Khenniche
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